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CONTENTS.

AGRICULTURAL CONFERENCE, 1907.

CACAO INDUSTRY.

FRUIT INDUSTRY.

LIME JUICE INDUSTRY.

COTTON INDUSTRY.

RICE INDUSTRY.

RUBBER INDUSTRY.

TOBACCO INDUSTRY.

ANIMAL INDUSTRY.

AGRICULTURAL CREDIT AND LOAN BANKS.

MISCELLANEOUS SUBJECTS.

AGRICULTURAL EDUCATION.

AGRICULTURAL CONFERENCE, 1908.

Vol. VIII. No. 1.

WEST INDIAN AGRICULTURAL CONFERENCE, 1907.

The representatives from Barbados, the Leeward and Windward Islands, Trinidad, and British Guiana, together with Sir Daniel Morris and other members of the staff of the Imperial Department of Agriculture, left Barbados on Tuesday, January 8, 1907, in the Imperial Direct West India Steamship 'Port Kingston' and arrived at Kingston, Jamaica, at daybreak on Friday, January 11. They were met on arrival by his Excellency the Governor (Sir J. A. Swettenham, K.C.M.G.) and Lady Swettenham, the members of the Reception Committee, and a large number of the principal officials, men of business, and planters of the island.

Arrangements had been made by the Reception Committee for a number of excursions to various parts of the island, and this part of the programme was at once proceeded with.

One party went to St. Catherine, under the guidance of the Hon Wm. Fawcett, to see banana, citrus, and rubber cultivations, and the cassava starch factory at Eltham Park. Another party, under the guidance of Mr C. E. de Mercado, left by special train at 8 30 a m. for Vere. They reached May Pen at about 9.30, and were met at the station by Mr. George Muirhead. Buggies were there awaiting them, and they drove straight to Dry River, where they were entertained by Mr. Clarence Lopez. The delegates had the opportunity of seeing what beautiful sheep were reared in Jamaica, and had the privilege of tasting the mutton.

The Hon. H. C. Ronaldson and Mr. George Murray joined the party at Dry River. The banana plantation of Mr. Lopez was visited. This afforded an opportunity of seeing one of the finest banana cultivations in the irrigated district, and the visitors were struck with the large proportion of big bunches. Mr. Lopez explained the process by which the bananas are timed to ripen during the summer months when the price is high, £12 per ton, whilst as little fruit as possible

is brought forward during the winter months when the price is low.

From Dry River the party proceeded to Hillside and to Pusey Hall, one of the properties of the Vere Estates, Ltd., to inspect a field of 30 acres under cotton cultivation. Those who were cotton experts were pleased with the cultivation, and they thought the crop showed great promise, considering the dryness of the season and the lateness of planting the seed. There was a very noticeable freedom from pests. The field is virgin soil and had not been ploughed, but for the next season it will be turned up with a steam plough and all the old tree roots cleared out.

Olive Park was next seen, and from there the party proceeded to Amity Hall, where they were met by the Hon. T. H. Sharp. After Amity Hall, they went on to Money Musk, the property of the Hon. C. J. Ward, where they were served with an excellent lunch. At the luncheon, the Hon. Dr. Watts expressed the thanks of the visitors to Col. Ward for his kind hospitality and also to all the gentlemen who had so ably assisted in contributing to the pleasantness of the trip. Mr. Harty expressed, on behalf of Col. Ward, his regret at not being able to be present, owing to the arrival of some members of his family by the ship. Mr. J. C. Elliot, the Revd. S. Negus, and Dr. Tillman kindly assisted in looking after the entertainment of the guests at Money Musk.

After an inspection of the works, the visitors were driven to Dr. Tillman's citrus grove at Camden. The packing house was examined and the grove inspected. The cultivation on the property was excellent. There is no orchard approaching Camden Grove in the West Indies for careful cultivation, and this is not to be wondered at, when it is mentioned that Dr. Tillman has spent over £6,000 on the establishment of the 40 acres that the grove covers. The oranges and tangerines are spineless and seedless.

After partaking of Dr. Tillman's hospitality, the visitors left on the return trip to May Pen, calling at Mr. Gillan's property, Parnassus, on the way to the Railway Station. They were all much interested in the fine new sugar factory that is being erected there, and at 6.30 p.m. the journey back to Kingston was commenced. The members interested in cane cultivation were much gratified at the optimism, in spite of the uncertainty of the Brussels Convention, displayed in the future of the sugar industry, as evidenced by the erection of new factories, and by extensive additions to older ones.

The Spanish Town party also had an enjoyable outing. All the delegates spoke in the highest terms of the excellent arrangements made by the management of the Railway, and certainly everything worked perfectly for their comfort. Great praise is due to the Reception Committee, and also to the various gentlemen who kindly loaned their traps for the conveyance of the guests, in making the outing such a splendid success.

On Saturday morning most of the delegates and several of Sir Alfred Jones' party, to the number of sixty, went out to

Port Antonio as guests of the Hotel Titchfield, to be present at the formal ball with which the management was opening the tourist season. Mr. R. A. Walcott conducted the party. On the way down, they stopped at Highgate Siding to visit banana cultivations and Messrs. Rowntree's cacao works, and at Orange Bay to see cacao and rubber. The function at the Titchfield was a great success. The great arch of palms and crotons over the driveway entrance with its words of 'Welcome' was the keynote of the night, and this vibrated through every detail of the entertainment. The guests were dined *al fresco* on the bay-side piazzas, where tables gaily trimmed with beautiful flowers gave a festive air to the scene. The ball was opened at 9 o'clock and dancing occupied the hours until midnight, when supper was announced. A banquet table spread down the centre of the dining hall, where the Conference delegates were seated, bore fitting evidence of the Titchfield's chef's skill. At the close of the supper, Viscount Mountmorres, in an eloquent speech, proposed the health of Messrs. Ainslie & Grabow, the proprietors of the hotel, and thanked Mr. Grabow for his hospitality, and for the treatment they had all received from him.

The return trip was undertaken on Sunday morning. At Annotto Bay a party of twelve left the train to drive through to Castleton Gardens. Luncheon was served at the Gardens, and the afternoon was spent inspecting them. Aftei a most enjoyable day, this party returned to Kingston in the evening.

On Saturday afternoon, his Excellency Sir Alexander Swettenham and Lady Swettenham held a reception at King's House, which was very largely attended. Among those present were the Bishop of Barbados and Mrs. Swaby, Sir Daniel and Lady Morris, Hon. St. John Branch, etc. At night a dinner party was also given at King's House by his Excellency the Governor and Lady Swettenham. About thirty-seven guests, including several visitors, sat to dinner.

CONFERENCE SERMON.

On Sunday, January 13, there was a special service at the Kingston Parish Church in connexion with the West Indian Agricultural Conference, when the Archbishop of the West Indies was the preacher. He took his text from 1st. John, ch. 1, v. 5 : 'God is light'; and Genesis, ch. 1, v. 3 : 'And God said, let there be light.' In passing to the practical applications of his subject his Grace said :-

'The existence and the operations of the Imperial Department of Agriculture with its various integral and allied sections, are a cogent example of the fact that in an age which seems almost entirely devoted to material interests and influenced by material considerations, they who will look deeply enough into things will find abundant evidences of the all-pervading and all-prevailing influence of mind over matter. The plan and purpose of the organization were conceived in the minds of one or two men. They were put into visible and tangible shapes, and, within a short period, the mental and physical energies of numerous collaborators and assistants were at work in every British West Indian Colony, inventing, discovering, experiment-

ing, and making the knowledge gained available, to increase the products and prosperity of these countries, and to rescue our communities from that poverty, stagnation and decay which threatened them. Light, knowledge, ideas, plans, purposes, mental determinations—these are the forces which control human affairs so far as that control is exercised by man. Mind rules matter: thought governs action: light is life.

'On behalf of those Christian people in Jamaica who are specially interested in the progress of scientific agriculture, I welcome to this Church and to this service the men whose scientific knowledge, experiments, and practical experience are quietly but steadily and effectively doing much to promote the interests of the present and the future generations of West Indian people.

'It is a fitting arrangement that the West Indian Agricultural Conference, now assembled in this city should, in accordance with the custom of such assemblies in the Mother Country, meet on this holy day in this place devoted to the teaching of religion and the worship of God. It is the direct purpose of the Christian religion to promote all human interests. The life of Jesus Christ and his teaching have inspired his truly instructed followers to aim at this. In what he taught and did are to be found the seeds of all progress in the service of humanity. Those who are specially set apart to do the work of the Church of Christ need to recognize that they are not the only workers who are carrying out the great aims of our Master: that life is more complex now than of old: that teachers and workers have to specialize, and bring learning and experience of special kinds to bear on the whole problem of humanity; and that while the plans and methods are diverse, there is a real unity in the work of those who are seeking truly to benefit the human race or any section of it.

'As I have intimated, the Agricultural Department of the West Indies and the official and unofficial members of the Conference have done and are doing much for the ultimate welfare of these islands. And there is great need for improvement and development. The brain worker and the capitalist need the encouragement and recompense which success in any department brings with it; and there is much that science and practical experience can do to help, both towards extending the operations and securing the profitable results of agriculture. And the labourer also needs to share fully in these beneficial developments. He needs lifting up to a higher level of intelligence, industrial power, and adaptability to modern methods and requirements. In many instances, he needs to have much better surroundings, more real comforts, more financial reward for his labour. He cannot fail to get these things if the progress we are all seeking be wisely guided, and if the benefit of the whole community be sought. Scientists, capitalists, experienced planters, intelligent labourers, are all needed for a new industrial progress in countries like these. And no true and permanent gain can be secured for one interest without the other interests benefiting.

'Some new conditions under which agriculture is being developed in the West Indies may be expected to furnish

special advantages for promoting the social, material, and moral welfare of the labouring population. This is a feature of the central factory system on the growth and manufacture of sugar and other products, which ought to be particularly interesting to those who are concerned in improving the condition of the general population. In those parts of the West Indies where land is available in proximity to a central factory, the small proprietor or settler can, under that system, have his own homestead where he and his family may live in comfort and in conditions which industry and frugality annually improve. On such a homestead he can cultivate for the central factory, he can supplement the income thus secured by the growth of various additional products; portions of the family can work on the large estate near by, receiving fair value for their labour, or on their separate cultivations on the estate. The prices will change according to the varying conditions of the market, but the manufacturer, the large planter or proprietor, the small planter or settler, and the small cultivator has each a share in the loss or gain resulting from the fluctuations in the market; and each contributes fully to the industrial progress of the community in which he dwells.

'And while the development (hardly begun in Jamaica) of the co-operative form of cultivation of the larger staples contains great possibilities of improved material and social conditions in those regions specially suited for it, the producer on a small scale of these and other products, in other places, will, I hope, share, in an increasing degree, in the advantages obtainable from good scientific and practical instruction, and from cheap facilities for the transport of his various products to good markets. We, in Jamaica, partly through the Direct Line of steamers, and partly through other enterprises, have begun to find the advantage of such facilities of transport, which I hope will be secured to us in even greater degree, and also be extended to other colonies. Scientific agriculture will do much for us; but continuity of development in production, and reliable access and means of transport to good markets are also essential to success.

'Speaking generally, the intelligent planter already is, and will increasingly become, interested in the real welfare of the labourers. Light has been obtained on many parts of the labour problem; and we need more. In connexion with the agricultural advancement, the question of improving the health condition of the labouring population needs to be studied, and practically taken in hand. I hope it will have attention at this Conference. In most West Indian communities the waste of life in early youth is very great. We need not only to save more of the young life, but also to aim at securing its growth into healthy and strong manhood and womanhood; and this must be sought by improvement in the methods and conditions of life in its early stages, and also in those stages which follow all through active mature life. This includes moral development and better modes of living generally, though not necessarily more expensive modes; and light on these subjects, which is already available, needs to be diffused.

'I must abruptly hasten to a conclusion. The subjects we have been considering have manifold ramifications. I have only presented ideas and suggestions in the most fragmentary way. I close with a few words relating to matters on which I feel not the less strongly because my words must be few.

'The whole aim of our agriculture as it affects the higher as well as the lower classes of the community should be progress, but not mere money making. Men can wisely strive to secure enough for comfort and for competence. When that is done, the object most to be desired is to have the time, thought, and opportunity for higher things, for intellectual, public, and religious interests—for all the higher things of life.'

In the afternoon, the Hon. H. Clarence Bourne, C.M.G., Colonial Secretary, Jamaica, and Mrs. Bourne gave an at home at the Priory that was largely attended.

The following is the list of representatives from the several West Indian Colonies, who attended the Conference :—

JAMAICA.

Representatives of the Board of Agriculture :—

The Honourable the Colonial Secretary (The Honourable H. CLARENCE BOURNE, C.M.G.) (Chairman).

The Director of Public Gardens and Plantations (The Honourable W. FAWCETT, B.SC., F.L.S.).

The Government Analytical and Agricultural Chemist (H. H. COUSINS, ESQ., M.A., F.C.S.).

The Superintending Inspector of Schools (The Honourable THOMAS CAPPER, B.A., B.SC.).

His Grace the Archbishop of the West Indies.

C. E. DE MERCADO, ESQ.

J. W. MIDDLETON, ESQ.

G. D. MURRAY, ESQ.

C. A. T. FURSDON, ESQ.

Representatives of the Jamaica Agricultural Society :

The Honourable Lieut.-Colonel C. J. WARD, C.M.G. (Vice President).

The Honourable Dr. J. PRINGLE, C.M.G. (Vice-President), and other members of the Board of Management.

BRITISH GUIANA.

The Representative of the British Guiana Board of Agriculture (The Honourable B. HOWELL JONES).

The Agricultural Superintendent (ROBERT WARD, ESQ.).

The Inspector of Schools (H. W. SCONCE, ESQ., M.A.).

TRINIDAD AND TOBAGO.

The Representative of the Trinidad Agricultural Society (The Honourable CARL DE VERTEUIL).
The Government Analyst and Professor of Chemistry (Professor P. CARMODY, F.I.C., F.C.S.).
The Superintendent of the Royal Botanic Gardens (J. H. HART, ESQ., F.L.S.).

WINDWARD ISLANDS.

The Agricultural Superintendent, Grenada (R. D. ANSTEAD, ESQ., B.A.).
The Agricultural Superintendent, St. Vincent (W. N. SANDS, ESQ.).
The Agricultural Superintendent, St. Lucia (J. C. MOORE, ESQ.).
The Inspector of Schools, St. Lucia (The Honourable C. F. CONDELL).
The Representative of the St. Lucia Agricultural Society (HENRY C. GRIST, ESQ.).

BARBADOS.

The President of the Education Board :—

His Lordship the Bishop of Barbados (The Right Revd. W. P. SWABY, D.D.).

The Agricultural Superintendent of Sugar-cane Experiments (J. R. BOVELL, ESQ., F.L.S., F.C.S.).

The Representatives of the Barbados Agricultural Society :—

The Honourable F. J. CLARKE, M.A., M.C.P. (President).
G. ELLIOTT SEALY, ESQ , M.C.P.
T. W. B. O'NEAL, ESQ., B.A., M.C.P.

Additional Representative for Barbados :—

GEORGE CARRINGTON, ESQ., B.A. (Cantab.), F.C.S.

LEEWARD ISLANDS.

The Representative of the Colony of the Leeward Islands (The Honourable E. ST. JOHN BRANCH, Colonial Secretary).
The Government Analytical Chemist and Superintendent of Agriculture (The Honourable FRANCIS WATTS, C.M.G., D.Sc., F.I.C., F.C.S.).
The Curator, Botanic Station, Dominica (J. JONES, ESQ.).

The Agricultural Superintendent, St. Kitt's-Nevis (F. R. SHEPHERD, ESQ.).

The Representative of the Dominica Agricultural Society (S. W. PENRICE, ESQ.).

The Representatives of the Dominica Planters' Association :—

The Honourable J. C. MACINTYRE, M.E.C.
J. COX FILLAN, ESQ., M.L.C.

OFFICERS
OF THE IMPERIAL DEPARTMENT OF AGRICULTURE FOR THE WEST INDIES.

The Imperial Commissioner of Agriculture for the West Indies (The Honourable Sir DANIEL MORRIS, K.C.M.G., M.A., D.SC., D.C.L., F.L.S.).

Entomologist (HENRY A. BALLOU, ESQ., M.SC.).

Mycologist and Agricultural Lecturer (F. A. STOCKDALE, ESQ., B.A.).

The Reception Committee, appointed by the Board of Agriculture and the Jamaica Agricultural Society, consisted of the Hon. H. CLARENCE BOURNE, Colonial Secretary, (Chairman), the Hon WM. FAWCETT, the Hon. Lieut -Col. WARD, ROBERT CRAIG, Esq., J. R. WILLIAMS, Esq., and JOHN BARCLAY, Esq., (Secretary).

HONORARY MEMBERS.

The following gentlemen were elected honorary members of the Conference :-

The Rt. Hon. the EARL OF DUDLEY, Viscount MOUNTMORRES, the Rt. Hon. H. O. ARNOLD-FORSTER, M. P., the Rt. Hon. JESSE COLLINGS, M.P., the Rt. Hon. Sir JAMES FERGUSSON, Bart., Mr. HOWELL DAVIES, M.P., Mr. HENNIKER HEATON, Mr. P. J. MURRAY HUNTER, Mr. CHAS. LANCASTER, Mr. J. LAWRENCE, Sir ALFRED L. JONES, K.C.M.G., Sir RALPH MOOR, K.C.M.G., Sir THOMAS HUGHES, the Hon. ALEXANDER McDONNELL, Mr. A. A. PEARSON, C.M G., Mr. ALEXANDER CRUM-EWING, Mr. HAMAR GREENWOOD, M.P., Mr. GERALD LODER, and Mr. JOHN TAYLOR.

Honorary Secretaries to the Conference: F. A. STOCKDALE, ESQ., B A, and ALLEYNE GRAHAM HOWELL, ESQ.

On Monday, January 14, at 11.30 a.m., the Conference was opened under the presidency of Sir DANIEL MORRIS, K.C.M.G., Imperial Commissioner of Agriculture for the West Indies, in the Old Mico Buildings, Hanover Street, Kingston, by his Excellency the Governor, Sir ALEXANDER SWETTENHAM, K.C.M.G.

In addition to the representatives from Jamaica, the other West India Islands and British Guiana, there were also present the large and distinguished party brought out by Sir ALFRED JONES, K.C.M.G., a large number of the leading planters and public men of the colony, and the following ladies: LADY SWETTENHAM, the COUNTESS OF DUDLEY, LADY MORRIS, Mrs. ARNOLD-FORSTER, Mrs. A. A. PEARSON, Mrs. SWABY, Miss COPELAND, and Mrs. WARD.

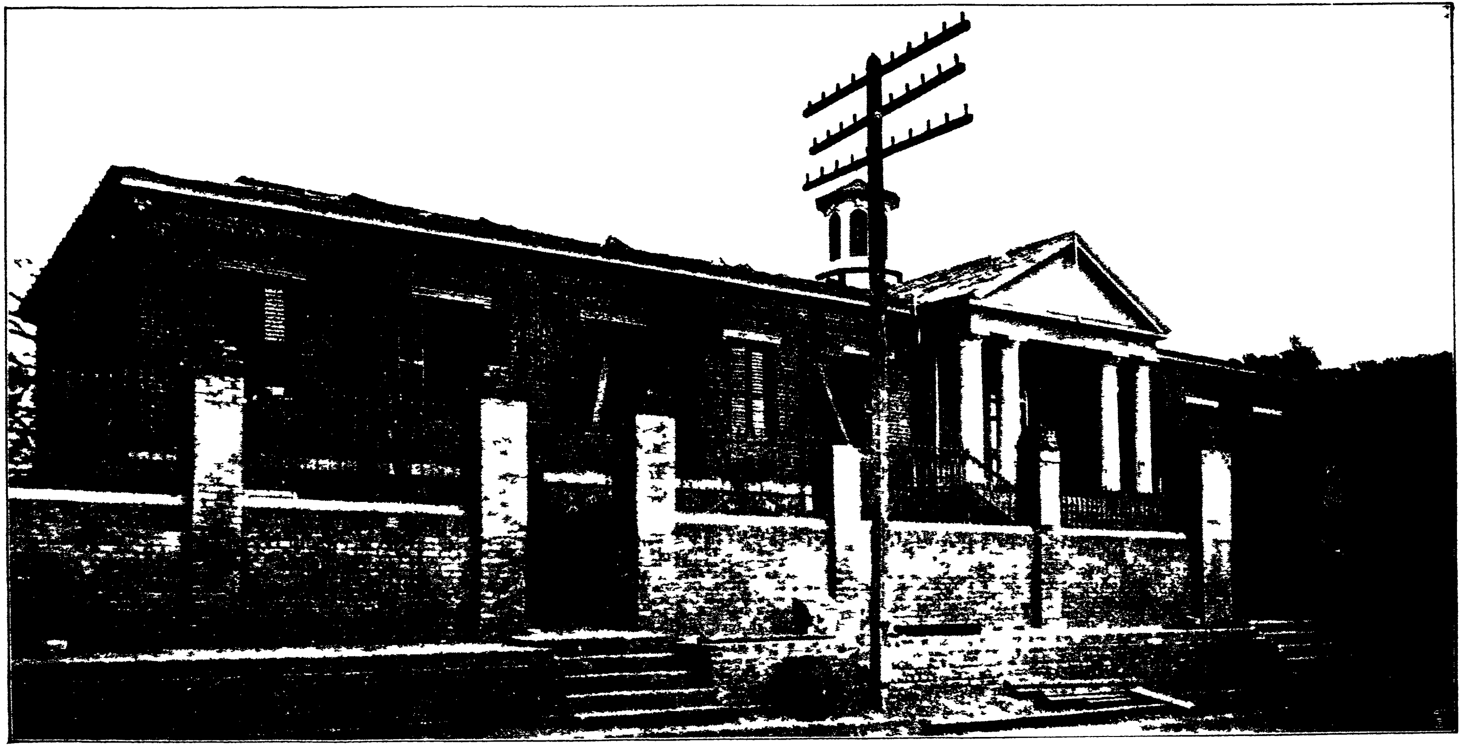

FIG. 1 Old Mico Buildings, Hanover Street Kingston where the West Indian Agricultural Conference was held After the earthquake—outside view

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FIG. 2. Old Mico Buildings. Hanover Street, Kingston, where the West Indian Agricultural Conference was held. After the earthquake—inside view of larger room showing props and supports subsequently added.

His Excellency the GOVERNOR, in opening the proceedings of the Conference, said: It is with peculiar pleasure that I find it is my good fortune to-day to open the first Conference of this kind which has been held in the colony of Jamaica. I believe this is the sixth Agricultural Conference which has been held in the West Indies, but it is the first which has taken place in this island. I am personally aware that last year Sir Daniel Morris went to considerable trouble in order to bring about a Conference in Jamaica, and it was a great disappointment to him and myself and this colony, that his efforts on that occasion were not successful. This present year, I congratulate him on the success which has attended his efforts. (Cheers.) I also wish to acknowledge the great debt that the colony owes to the generosity of Sir Alfred Jones. (Applause.) If it were not for the very great interest that he has taken in the colony all along and for his generosity on this occasion, I am afraid it would have been impossible to have held a Conference this year. I will not trouble you with a long speech. I know there is an enormous amount of work to be done and that the delegates are very anxious to get to business. I can only say that, speaking as an individual, my belief is that we in Jamaica have an enormous lot to learn from the delegates to this Conference. I am afraid we shall have a deal more to learn from them than they can learn from us. Of course, that is my own individual opinion, and I do not wish to pledge Jamaica to it. I believe there is a great deal of business before us and we shall have very interesting papers which will be of value, not only to Jamaica, but to the whole of the West Indies and to tropical islands and countries beyond this hemisphere. I wish to welcome to Jamaica on this occasion the very influential, distinguished and numerous company which Sir Alfred Jones' kindness has brought to these shores. I welcome them in the name of Jamaica, and assure them how highly gratified we are to see so many people here present—people who carry such weight in the whole of the British Empire. In the name of the colony, I wish to extend to them a welcome, and I hope that such of them as are visitors for the first time will continue to pay us the compliment of coming here, and that every year, as they come, they will see greater progress around them, due to all the agencies to which progress is due, and last, but not least, to the exertions of conferences of this kind. I now declare this Conference to be open, and I call upon Sir Daniel Morris to deliver his presidential address. (Applause.)

PRESIDENTIAL ADDRESS.

Sir DANIEL MORRIS then rose and said:-

My first duty as President is to extend a hearty welcome to the Representatives of the various colonies who are gathered here to-day to attend the Sixth West Indian Agricultural Conference It is a source of great satisfaction to me that it has been found possible to arrange for this Conference to be held at Jamaica, where I have spent some of the best years of my life and in which I continue to take a deep interest. Probably in no part of the tropics could be found such diversified agricultural con-

ditions as exist in Jamaica, and it is, in consequence, singularly favourable as a meeting place for those interested in tropical agriculture.

I desire to express my deep appreciation of the excellent arrangements made for this Conference by the Reception Committee, and I would also acknowledge the generous hospitality offered by the people of Jamaica to the representatives to this Conference, who during the last few days have been enabled to visit various districts and thus become acquainted first hand with the industries of the island.

The business to be undertaken at this Conference is already set forth in the papers now before you.

SUGAR INDUSTRY.

As at previous Conferences, the circumstances of the sugar industry will receive first attention. The position of this industry from the purely agricultural point of view is not of an unpromising character. The results of recent experiments in raising improved varieties of seedling canes, less susceptible to disease and yielding a larger amount of sugar are encouraging. Facts will be laid before the Conference which will leave no doubt that, under certain circumstances, seedling canes are proving more remunerative than the old varieties. There are still more promising seedling canes under experimental trial. The breeding of hybrid sugar-canes is being steadily carried on in a systematic manner. As the testing of a new seedling cane is required to be carried on for several years before it can be recommended for general cultivation, the work must necessarily proceed at a slow rate.

The diseases of the sugar-cane that were so prominent a few years ago are not now of a markedly pronounced character. In many cases, this is due to the substitution of seedling canes for those previously in use. It will still be necessary, however, to exercise considerable watchfulness in order to prevent any disease establishing itself to such an extent as to become a source of anxiety to sugar planters. The principal cane diseases have been exhaustively studied, and their treatment placed on record. A handbook entitled 'Lectures to Sugar Planters' has recently been published by the Imperial Department of Agriculture, and this gives much valuable information in respect to insect pests and fungus diseases of the sugar-cane, in addition to important data having reference to cultivation, etc.

Possibly, the most important matter to bear in mind in connexion with the sugar industry at the present time is the necessity for reducing the cost of production. This, it is suggested, might be done by selecting the richest canes suited for each locality; by the larger use of labour-saving implements; by preparing and utilizing supplies of good pen manure; and by the more skilful use of artificial manures, where these can be advantageously used. Also by growing, to a larger extent than at present, the food stuffs and supplies imported from other countries.

In addition, there is the absolute necessity for steady improvement and economy in the manufacture of sugar, so as to prevent the loss now accruing, especially in the case of muscovado sugar. It is also important to produce exactly the right kind of sugar required for refinery purposes in Canada and the United States, and the yellow and other crystals in demand in the United Kingdom.

The recent introduction of steam ploughing on sugar estates at Trinidad and Antigua is a feature worthy of mention. Also, the erection of a Central Sugar Factory at Antigua. This latter cost £42,000, and is capable of dealing with from 3,000 to 4,000 tons of sugar in 100 days. The first report on the Antigua Central Sugar Factory was published in the *Agricultural News*, Vol. V, p. 49. The second report will probably be issued shortly.* I have no doubt that a sugar factory similar to that at Antigua would be likely to be successful at St. Kitt's.

It is evident that, at this moment, the Dominion of Canada offers a favourable market for West Indian sugar and molasses. This is strikingly shown by the following table illustrating the value of the sugar and molasses imported into Canada from the British West Indies and British Guiana during the last three years :—

Articles.	1904.			1905.			1906.		
	£	s.	d.	£	s.	d.	£	s.	d.
Sugar ..	1,111,613	10	10	1,351,093	6	8	1,476,958	19	2
Molasses..	87,482	14	2	141,476	13	4	162,326	13	4
Total	1,199,096	5	0	1,492,570	0	0	1,639,285	12	6

In the new Tariff recently adopted in Canada, the preference to British-grown sugar is continued.

It is impossible at an Agricultural Conference of the West Indies to avoid a reference to the general anxiety felt throughout those colonies where sugar is the staple product as to whether the Brussels Convention is likely to be maintained. After careful consideration of all the circumstances, it has been decided to appoint a Committee consisting of representatives closely interested in the sugar industry and to refer to such representatives the preparation of a statement containing replies to the following questions :—

(1) What has been the effect of the Convention in the West Indies?

(2) What effect has the recent uncertainty as to its continuance had?

* See *Agricultural News*, Vol. VI, p. 131.

(3) What would be the probable effect of its non-continuance?

By such means it may be possible to place on record facts likely to be of value when the question of the continuance of the Convention comes up for consideration. At the same time, the fact cannot be ignored, that the Canadian market is already taking three-fourths of the sugar produced in the West Indies, and it is not improbable that before long, with the rapid expansion that is taking place in the Dominion, it may eventually take the whole of the West Indian output.

CACAO INDUSTRY.

The cacao industry of the West Indies, of the annual value of about £1,574,330 also will receive consideration. The general distribution of diseases of cacao trees is naturally a source of anxiety, and considerable attention has been devoted to their life-history and to the precautions to be adopted in order to keep them in check. Experiments in manuring cacao plantations have been continued. Some of these are of a striking and interesting character, showing that with a little extra care in cultivation, the prompt treatment of diseases, and with the use of suitable manures, the production per acre may be increased over large areas to the extent of 20 to 25 per cent.

FRUIT INDUSTRY.

The value of the bananas, oranges, and grape fruit exported from Jamaica has for some years reached nearly one million sterling. A fruit trade is in course of being established by a local company at Trinidad, and bananas are to some extent still exported from Barbados. The export of fresh limes from Dominica is steadily increasing as a result of the successful exhibition recently held in the United Kingdom.*

As regards the fruit industry generally, probably the most important matter for consideration is not the extension of the areas already under cultivation, but the better handling, especially of citrus fruits, for export purposes. The annual loss arising from careless packing and marketing of oranges and grape fruit amounts to many thousand pounds, nearly the whole of which might be saved by organized efforts on the part of growers and shippers.

LIME JUICE INDUSTRY.

The lime juice industry (including the export of fresh fruit, raw and concentrated juice, and distilled and essential oils of limes) appears to have a very promising future, especially if, in addition, the manufacture of citrate of lime is taken up on commercial lines. This, it is claimed, would effect a saving of the citric acid now lost in evaporating the raw juice. Already

* In 1906-7, Dominica exported 15,790 barrels of fresh limes of a value of £5,530, as against 13,564 barrels, valued at £4,747, in the previous year.

the manufacture of citrate of lime has been taken up at Dominica and Montserrat. The value of lime juice exported in 1905-6 from Dominica is placed at £32,986, and Montserrat exported £7,117 worth of lime products.*

A paper on the manufacture of citrate of lime will be submitted by Dr. Watts.

COTTON INDUSTRY.

The Sea Island cotton industry is comparatively new. Thanks, however, to the valuable assistance rendered by the British Cotton-growing Association, it has made rapid progress during the last five years. The total area under cultivation in Sea Island cotton this year is nearly 15,000 acres ; while about 3,600 acres are under cultivation in what is known as *Marie Galante* cotton at Carriacou and elsewhere. The table below will illustrate the position of the industry. It will be observed that the total value of the lint and seed produced during the last five years amounts to over £200,000 :—

STATEMENT SHOWING THE TOTAL AMOUNT AND VALUE OF COTTON LINT AND SEED PRODUCED IN THE BRITISH WEST INDIAN COLONIES FROM JANUARY 1, 1902, TO DECEMBER 31, 1906.

Year.	Weight of lint in pounds.	Estimated value of lint.	Estimated value of lint and seed.
		£	£
1902	328,530	7,366	9,676
1903	397,541	9,031	11,873
1904	698,981	26,930	31,891
1905	1,122,800	47,846	63,290
1906	1,577,431	69,092	90,092
Total for 5 years.	4,125,283	160,265	206,822

The present season, I regret to state, has not been so favourable as could have been wished. In addition, the great prevalence of insect pests has necessitated increased expenditure in the application of Paris green and lime. An important feature is the enhanced prices which have prevailed, owing to the falling off in the supplies of Sea Island cotton (due to the same causes) in the United States.

* In 1906 7, Dominica exported lime juice to the value of £44,486, an increase of £11,520 over the production of the previous year, and citrate of lime to the value of £1,503.

The Central Cotton Factories at Barbados and Antigua have now been taken over by local co-operative companies. A new factory capable of dealing with seed-cotton produced from 5,000 acres has just been opened at Barbados. The Central Cotton Factory at St. Vincent is still being carried on under the direction of the Imperial Department of Agriculture. A central ginnery and an oil factory have been started at Nevis.

It is a matter of regret that, so far, the cultivation of Sea Island cotton has not been successfully established at Jamaica. The causes for this are stated in the Governor's report for 1904-5, p. 21. I am not without hope that further efforts will be made to start cotton growing on right lines. There is no doubt that there are many districts in the island exactly suited to the industry. The employment of an entomologist would be a satisfactory means of dealing with the insect pests which injuriously affect not only cotton but other crops in the island.

RICE INDUSTRY.

Rice cultivation in British Guiana has now assumed such importance that it deserves careful consideration. The total area under rice in the year 1904-5 was placed at 21,920 acres; the crop was estimated at 22,597 tons of paddy, equal to 15,600 tons of cleaned rice. The probable value of this would be about £175,000.

According to the report of the Comptroller of Customs, rice was first exported from British Guiana in 1902-3, amounting to 10,506 lb., of the value of $290·04. In 1904-5 the exports reached 61,225 lb., of the value of $1,709·44; while in 1906-7 the increase was considerable, the exports amounting to 3,474,512 lb., of the value of $89,078·21 (£18,000).

Fuller information in regard to the rice industry of British Guiana will be presented by the Hon. B. Howell Jones. Rice is also cultivated to some extent in Trinidad, Jamaica, and St. Lucia.

RUBBER INDUSTRY.

There are few subjects attracting more attention just now than the outlook for supplies of raw India rubber to meet the increasing demand for this article. Sources of new supplies of rubber are being investigated, as well as the prospects for cultivating rubber trees with the view of supplementing the supply from wild trees. Possibly the largest experiments in cultivating rubber in the West Indies are being undertaken at Trinidad and Tobago.*

A good deal of interest is also being taken in exploring portions of British Guiana for indigenous rubber trees and in starting regular plantations.

* In 1906-7, Trinidad exported 1,067 lb. of rubber of a value of £174, and recently a shipment of 6 cases of Castilloa rubber, sent from that colony, has been valued at 4*s*. 4*d*. per lb. on the English market.

The three principal trees that are being introduced into cultivation are the Para rubber (*Hevea brasiliensis*), the Castilloa rubber (*Castilloa elastica*), and the West African rubber (*Funtumia elastica*). To these may be added the species of *Sapium* said to yield commercial rubber in the hinterland of British Guiana. The relative merits of these several trees mentioned are still being keenly discussed. In this part of the world, *Castilloa elastica* is more largely planted than any other. This is no doubt due to the fact that it is native of tropical America and that supplies of seed are easily accessible in large quantities. In spite of this, however, further information is desired as to the best methods for cultivating and tapping the *Castilloa* tree, and as to the conditions under which it should be placed to produce the best results. Also whether, under all circumstances, it is a suitable tree to be used as shade for cacao.

Several papers will be presented to the Conference supplying information in regard to the cultivation of rubber trees in these colonies.

TOBACCO INDUSTRY.

Jamaica is practically the only portion of the West Indies where tobacco cultivation is being carried on to an appreciable extent. The value of the tobacco and cigars exported from Jamaica has increased from £7,648 in 1895-6 to £22,274 in 1904-5. It is probable that a considerable extension of the tobacco industry in this island would take place if the Admiralty were disposed to take Jamaica leaf tobacco to blend with Virginian tobacco in the Royal Navy. Information in regard to the Jamaica tobacco industry will be presented by Mr. Fawcett, the Director of Public Gardens and Plantations. On a moderate scale, tobacco is being grown and made into cigars at Trinidad and St. Vincent, while tobacco for local consumption is produced at Antigua, St. Kitt's, and other islands.

ANIMAL INDUSTRY.

Considering the large amount of capital invested in the animal industry in the West Indies, it would be of advantage if greater attention could be devoted to it. In recent years, considerable sums have been expended in the introduction of pedigree animals. It is evident, however, that a good deal more might be done in the selection of the right class or breed of animals to suit special localities, so as to obtain the best results. The occurrence of anthrax, and the treatment of ticks and other diseases also deserve to be more fully dealt with. The improvement of stock, generally, has a direct bearing on the success of nearly all agricultural industries in the West Indies. As pen keeping is so prominent an industry in Jamaica, the visitors from the colonies will, no doubt, be interested to visit the districts where some of the best horses and cattle are successfully raised.

It is satisfactory to learn that the recent outbreaks of anthrax in the colonies of British Guiana and Trinidad, and in one instance at Grenada, have been successfully dealt with There is no doubt that, where energetic steps are taken under

the direction of competent officers, including the isolation of infected areas and the use of vaccine, the disease can be kept under control. The services of the Professor of Comparative Pathology of the School of Tropical Medicine at Liverpool (Dr. Annett) have been kindly placed at the disposal of the Imperial Department of Agriculture with the view of making investigations and suggesting remedial measures in connexion with the occurrence of sporadic cases of anthrax in the island of St. Vincent. A leaflet has recently been issued for the guidance and information of those living in districts where anthrax has broken out, with the view of making known the nature of the disease and the best means for getting rid of it.

AGRICULTURAL CREDIT AND LOAN BANKS.

At the Conference held at Trinidad in 1905, Mr. Fawcett read a paper on Raiffeisen Agricultural Banks, with the view of encouraging the formation of Agricultural Loan Banks on a popular basis in Jamaica and elsewhere in the West Indies.

This paper was afterwards published in Pamphlet form (No. 35 of 1905) by the Imperial Department of Agriculture with an Appendix containing the rules of the Agricultural Bank issued by the Irish Agricultural Organization Society. Since that time, the subject has continued to receive attention. A paper on 'An Agricultural Loan Bank in Operation' will be presented by the Rev. Dr. Turner of Jamaica.

An article on Agricultural Credit in Germany (taken from the *Journal* of the Board of Agriculture for March 1906) appears in the *West Indian Bulletin* (Vol VII, p 317). It would seem that in Germany there are 1,595 societies to assist small cultivators in the purchase of agricultural requisites; 3,062 societies for encouraging the raising and preparation of dairy and other products, with 682 other co-operative agricultural societies. All these appear to be engaged in the work of assisting in the general development of agricultural industries.

The subject is one that deserves to be fully taken into consideration by the Agricultural Societies in the West Indies, with the view of ascertaining whether it would be possible to start agricultural banks or co-operative agricultural societies, such as those existing in Germany, amongst cultivators in these colonies.

GENERAL.

In the General Section, a number of interesting papers will be presented, such as 'Tea Growing in Jamaica' by the Hon. H. E. Cox, and 'The Industrial Prospects of Cassava Starch' by Mr. H. H. Cousins The growing of tea in Jamaica has been proved to be capable of becoming a successful industry. Steady progress has been made in improving the quality of the tea which is now in increasing demand in those and other colonies. It may be interesting to mention that the only other locality in the New World where tea is being produced on a moderately large scale is in South Carolina.

Cassava starch appears to be in good demand in the United Kingdom, and it would be of great advantage if tracts of land not suitable for other products could be utilized for the cultivation of the cassava plant. The figures to be placed before the Conference by Mr. Cousins are of a distinctly promising character

AGRICULTURAL EDUCATION.

Notwithstanding that Agricultural Education is placed last on the list of subjects for this Conference, I am not without hope that it may receive more than ordinary attention.

During the last seven years, considerable efforts have been made to encourage the more general use of object-lessons and what is known as 'Nature Teaching,' with practical training in school gardens in connexion with the elementary schools in the West Indies. In addition, Tropical Readers and other text books have been provided, and the teachers have received special instruction and a course of training with a view of enabling them to give the right kind of teaching, and to present it in as attractive a form as possible. The results, I regret to say, have not been so successful as could have been wished, owing, possibly, to the fact that the inducements offered for nature teaching and maintaining school gardens have not appealed to the teachers, who find under the existing codes that they can earn larger grants by devoting attention to other subjects.

It is desirable that a full discussion of the situation as we now find it should take place, in order that the teaching of agriculture may be placed on such a footing as to bring the younger generation in these colonies into closer sympathy with the chief business of their lives, namely, the cultivation of the soil.

As I have already pointed out, not only in the West Indies, but in all agricultural communities, the need of the hour is the education of the rising generation in the knowledge of how to obtain from the soil those products for which there is a good demand in the markets of the world. Ignorance and ineptitude can never produce successful results.

The prevailing practice amongst the small cultivators in the West Indies is to take everything out of the land, and if it is rented, to abandon it immediately afterwards. Even where they have their own plots of land, these are not cultivated to the best advantage, and the necessity for preparing and using manure is seldom recognized.

As already mentioned, we must begin with the young if we are to obtain results of a permanent character. We should renew our efforts to instil a love of caring for plants and animals and of the right treatment of the soil amongst the young during school life. This may be accomplished by means of attractive object-lessons and interesting work in school gardens. Later, we might utilize the living voice of the travelling agricultural instructors so as gradually to change

such agricultural methods as are known to be unsound, and injurious to the true progress of the community.

In addition, the institution of school shows, where children from various schools can compete amongst themselves with plants and produce grown in school gardens, or where produce from school gardens is admitted for competition at the annual agricultural shows, would afford useful means for encouraging both teachers and scholars in agricultural work.

The annual course of lectures to teachers with practical instruction at the Hope Gardens as carried on in this island, is an admirable means of spreading a sound knowledge of agriculture.

The agricultural schools maintained by the Imperial Department of Agriculture at St. Vincent, St. Lucia, and Dominica, where selected boys fifteen to eighteen years of age are boarded and trained for a period of three to four years, have now clearly demonstrated the value of such schools in raising the standard of cultivation and in spreading sound knowledge respecting the treatment of crops. Many of the boys trained at these schools have already obtained employment as foremen and overseers on estates Others are successfully working on land belonging to their parents or guardians.

The work of the lecturers provided for teaching elementary science and the principles of agriculture to the pupils at Harrison College, Barbados, and the Queen's Colleges at British Guiana and Trinidad, as well as in this island, is steadily being carried on. This teaching of scientific agriculture enables young men to fit themselves for occupying responsible positions on sugar and other estates. Their motto should be that of the Royal Agricultural Society of England: 'Practice with Science.'

AGRICULTURAL SHOWS.

Agricultural Shows continue to be held in all parts of the West Indies. In many instances, as in Jamaica, they are organized by the Local Agricultural Society. It is a most encouraging feature of these shows that they receive the cordial support and the interest of all classes of the community. I have no hesitation in stating that the Agricultural Shows held in Jamaica are probably the most successful and extensive of any shows in the West Indies. Excellent shows are also being held in British Guiana, and the several school-garden shows so successfully held in Trinidad are a feature worthy of being followed in the other colonies. The Agricultural Shows held in the smaller islands, such as Montserrat, Nevis, and the Virgin Islands, are having a good educational influence, and deserve encouragement.

The best results are probably obtained where the shows are held in the country districts, and not necessarily in the chief town of the colony. By such means, the interest of cultivators in the out-districts is enlisted, and the stimulating influence of the shows is spread over a wider area.

AGRICULTURAL PUBLICATIONS.

I am glad to report that interest is maintained in the issue of literature relating to agricultural subjects in all parts of the West Indies. The *Bulletin* of the Department of Agriculture at Jamaica and the *Journal* of the Jamaica Agricultural Society take a high place amongst such literature. I would also mention the quarterly *Bulletin* issued by the Botanical Department at Trinidad, and the *Proceedings* of the Trinidad, Grenada, and Dominica Agricultural Societies.

It is encouraging to find that the public press affords increasing amount of space to the discussion of agricultural subjects, and to the diffusion of information bearing on local industries. This is a feature which cannot fail, eventually, to have a beneficial influence in up-lifting the general prosperity of the West Indies.

The Imperial Department of Agriculture has continued the publication of the fortnightly *Agricultural News*, and the quarterly *West Indian Bulletin*. In addition, pamphlets have been issued, embodying the results of experiments with seedling canes and manures, the cultivation of cotton, oranges and tobacco, and hints to intending settlers, and also Annual Progress Reports (nine in number) on the several Botanical and Experimental Stations, Agricultural Schools, and Agricultural Education. A Blue Book Report on the 'Working of the Imperial Department of Agriculture in the West Indies' was presented to Parliament in April 1906.

FUTURE OF THE IMPERIAL DEPARTMENT OF AGRICULTURE.

As recently announced in Parliament, His Majesty's Government has decided to provide for the Imperial Department of Agriculture for a further term of five years, from April 1, 1908, to March 31, 1913. It has been laid down that whilst the Home Treasury will still continue to bear a proportion of the cost of the Department, the grant will gradually diminish on a progressive scale from £14,420 for 1908-9 to £7,000 for 1912-3. During that period from 1908-9 to 1912-3, the Imperial Commissioner of Agriculture (with the approval of the Secretary of State) will confer with the Colonial Governments concerned with a view to obtaining, as from April 1907, increasing and (if possible) progressively increasing contributions towards the cost of the local agricultural institutions from such colonies as may be able to afford them.

It is hoped that the proposal of the Imperial Government to assist these colonies to continue the work of the Imperial Department of Agriculture for a further period of five years will be acceptable to the colonies concerned, and that the several Legislatures will contribute, as far as their means will permit, towards the support of the agricultural agencies now existing amongst them. It is intended that the contributions from colonial funds will be devoted entirely to local purposes. No portion will be required for the maintenance of the Head Office. It is understood that the continuance of grants from

Imperial funds for the support of local institutions will be conditional on their remaining to the same extent, as at present, under the general control of the Imperial Commissioner of Agriculture.

I believe it is now recognized that the existence of a central authority in agriculture is essential for the fuller development of these colonies. Such a central authority would be available to take such steps as are advisable and necessary to improve and increase the quality and quantity of agricultural production, to cheapen its cost by new and superior processes, and to diminish wastage and loss by disease and other avoidable causes.

In addition, it would fulfil other functions, such as to collect, elaborate, and examine technical and economic information in regard to the cultivation of the soil, its productions—whether animal or vegetable—and the best openings for the disposal of agricultural produce. It will also notify the occurrence of new diseases of plants and animals, the circumstances favouring the spread of such diseases, and the most economical and effective way of dealing with them. Such a central authority might also bring together facts relating to agricultural operations, insurance and credit in other countries, and advise the several Governments and Agricultural Societies in promoting and organizing undertakings for the general development of agricultural interests.

With the experience of the past years before us, it should be possible to widen the scope of the operations of the Imperial Department of Agriculture and bring them into still closer touch with the requirements of these colonies.

His Grace the ARCHBISHOP OF THE WEST INDIES: Your Excellency, My Lords, Ladies and Gentlemen,—I have risen to move a vote of thanks to Sir Daniel Morris for the Address to which we have just listened. I came to this meeting under the unusual and happy feeling that I had nothing to do to-day but to sit and listen. I do not mention that by way of excuse, but it would have been convenient to me, with the view of trying to shorten what I may wish to say, if I had known before entering the room that I was going to move this vote of thanks. However, I do it with the greatest possible pleasure, and with the conviction that the West Indies generally owe to Sir Daniel Morris very much for that which is, at present, a reasonably satisfactory prosperity, and I hope that this will before long develop into a larger prosperity.

As I have now for very many years watched the career of Sir Daniel Morris, I have realized how the daily duties of a man, who seeks to do his utmost, constitute a preparation for things that he may not have expected, but which, under God's providence and the nation's needs, may have been in store for him. It is owing to the wide experience which Sir Daniel Morris has gained during many years, together with an intensity of conviction and a deep interest in his work, that

he has been able, in these later years, to accomplish so much by means of the Imperial Department of Agriculture in behalf of the West Indies. I know that one part of Sir Daniel Morris' work—perhaps the most difficult part—has been the smoothing away of difficulties, the combining of the interests and efforts of individuals of various opinions and positions, who had previously either not thought much or had not taken effective steps to bring their views into practical operation. All this has needed knowledge and experience, determination, persistent effort, and the power of conviction, and I congratulate Sir Daniel Morris and the West Indies on the fact, that the Imperial Department of Agriculture for the West Indies has been brought to a point where there is an identity of feeling as regards the value, importance, and necessity of united effort to promote agriculture in these colonies on lines at once practical and scientific. (Cheers.)

It is a happy circumstance that the generosity of Sir Alfred Jones has enabled Sir Daniel Morris to bring about the holding of this Conference in Jamaica, and also made it possible for us to welcome to Jamaica men of knowledge and experience, in the hope that we may secure the benefit of their suggestions and criticisms upon our efforts in this colony.

One of the things I am most gratified about in these later years is that the old spirit that there is nothing to learn is dying out, if it is not already dead. (Cheers.) I remember that at one of the earliest meetings we had in a country district, all the village people and the surrounding folk came to listen to a lecture delivered by one of our Agricultural Instructors. The meeting was presided over by my late coadjutor, Bishop Douet. The lecture was largely on the use of manure, and when it was over the Chairman asked for questions and criticisms. An old black man got up and said: 'Well, Bishop I do not believe much of what the lecturer tells us to-night. God Almighty mek de lan, and no man can improve 'pon dat.' (Laughter.) I think there was more devotion in that statement than ignorance of science.

We have endeavoured, in these later years, to put elementary education, and to some extent secondary education, on such a footing that while not neglecting that training of the mind generally, which is always useful, there should be a special effort to fit members of the younger generation for their future life and to interest them in the agriculture of the country. The idea is not to make them trained artisans or trained agriculturists, but to surround them with an atmosphere of agricultural interests, to fill their young lives with the feeling that it is no dishonour to work upon the land—further, to regard plants as living things which God has made and man must take care of.

Sir Daniel Morris made reference to one point which I will briefly touch upon, and that is, the Brussels Convention. It is another happy result of the circumstances which have brought us together to-day, that we have also, besides those officially connected with the Conference, some

well-known representatives of the British Parliament, men whose career some of us have watched for many years, whose life work is known, and whose names are household words all over the Empire. (Applause.) I am glad they are here to-day, and I wish more of such representative men could come from time to time to visit the West Indies.

Some of us feel continually that one of the difficulties of our colonial life, and especially in the smaller colonies, is that there is danger of our being like the shuttle-cock, twisted and turned and moved about from party and not from Imperial considerations What I mean is this: that I do not think that the Army and Navy and certainly colonial affairs should become a matter of discussion or debate on party lines. (Prolonged cheers). There is a practical reason for that, and it comes out of the address. Sir Daniel Morris is going to propound three questions as to the effect of the Brussels Sugar Convention in connexion with the sugar industry in the West Indies. What effect it has had? What are the present prospects? And what is the future likely to bring forth? My point is that, unless there is likely to be some continuity of administration in matters like that, it is impossible for these colonies ever to establish large and successful industries. (Cheers.) What is the chief value of the Brussels Convention to us? Stability. Knowing that the industry is on a natural level. Now, what can we do, if every three years a change of Government means a change of policy and the upsetting of everything? It may be answered that the British Government is not the only Government concerned. Of course not. But the British Government, if it chooses to go into the Convention with a strong hand as it did on the last occasion, may always turn the scale. (Cheers.) I hope Sir Daniel Morris will obtain full, intelligent answers to the questions put by him.

And again, as to the existence of the Imperial Department of Agriculture. My earnest hope is that that Department will be continued. (Cheers.) I think it is of the greatest possible advantage to all the West Indies. With due regard to local control of moneys raised, I think it would be of great value for Jamaica to be connected with that Department more than it is at present. I am glad to see that the present Government has pledged itself to continue the grant for the next five years, and I think our local people should do what they can in the matter.

I am afraid I have occupied you too long, Mr. President, but I desire to express to you the greatest thanks for the admirable Address that you have delivered, and—I should like to add personally—for your services to the West Indies. (Applause.)

The Hon. B. HOWELL JONES (British Guiana): I feel it my duty as a member of this Conference to accept the duty imposed upon me by my colleagues, to thank Sir Daniel Morris, and to second the vote of thanks which has been proposed to him, for the extremely good work which he has done for the West Indies. I have followed closely the work of the Imperial Department of Agriculture; I have seen it grow from a small beginning to a Department of vast importance,- one which is looked upon with confidence, and one to which we may look

for a great deal of assistance and help in the future. We rejoice that Sir Daniel Morris has persuaded the Imperial Government to continue the Department for another term of five years. I hope they will continue to give us that assistance until they see us grow to manhood, and see these colonies resume their former position as gems in the British Crown. In seconding this vote of thanks to Sir Daniel Morris, I think I should be neglecting my duty if I did not also, through him, express our grateful thanks for the assistance which has been rendered by those who form the establishment at the Head Office at Barbados. Moreover, I do not think I shall create a feeling of jealousy if I particularly mention the name of Mr. John R. Bovell. (Applause.) Mr. Bovell's researches in raising sugar-canes from seed, carried out at Barbados, and the advice given by him to planters were the first real steps towards the knowledge which we have since gained in growing seedling sugar-canes. We in the West Indies look upon Mr. Bovell as one of our most able authorities, and Sir Daniel Morris will acknowledge that he is his right-hand man, in many ways.

The PRESIDENT, in responding, said: I feel more than compensated for all the trouble I have had in arranging for this Conference by the very kind reception which the Imperial Department has received in this island to-day. I thank His Grace exceedingly for the very able speech he has made, and for the thoroughly interesting manner in which he has reviewed the position of agricultural efforts in the West Indies. I also thank my friend Mr. Howell Jones for the kind words that have fallen from him. I am glad that he drew attention to the valuable services rendered by the officers of the Department who so loyally and effectively assist my efforts. I entirely agree with what has been said in respect to the special services rendered by Mr. J. R. Bovell, and I would also mention how much I am indebted to the excellent work done in the Leeward Islands by Dr. Francis Watts. (Applause.) There are other indefatigable workers scattered throughout the length and breadth of the West Indies imbued with the same spirit, and the success of the Department is due to the hearty co-operation of all such men. I may also add that the Department has consistently received cordial assistance from the several Governors and Administrators and Government officials generally, as well as from the Presidents and members of the Agricultural Societies, and numerous individual planters scattered over the whole of the West Indies. Therefore, what is presented to you to-day is the result of the combined efforts of all who are interested in the welfare and prosperity of these colonies. (Applause.)

The following Committees were then appointed :—

SUGAR COMMITTEE: Hon. F. J. Clarke (Barbados), Chairman; the Hon. B. Howell Jones (British Guiana); the Hon. Carl de Verteuil (Trinidad); the Hon. Lieut.-Colonel Ward (Jamaica); Messrs. George Carrington (Barbados); G. D. Murray (Jamaica); G. E. Sealy (Barbados); and C. E. de Mercado (Jamaica), Secretary.

EDUCATION COMMITTEE: His Grace the Archbishop of the West Indies (Jamaica), Chairman; the Bishop of Barbados; Canon Simms (Jamaica); the Hon. Dr. Francis Watts (Antigua); Professor Carmody (Trinidad); the Hon. C. T. Condell (St. Lucia); Messrs. H. W. Sconce (British Guiana); A. B. Macfarlane (Jamaica); Geo. Hicks (Jamaica); and J. R. Williams (Jamaica); and the Hon T. Capper (Jamaica), Secretary.

The President mentioned that, after the recess, the Conference would resume at 2.30 p.m. and take up the consideration of subjects affecting the Sugar Industry. On Tuesday at 10 a.m., they hoped to discuss points connected with the Cacao, Fruit, and Lime Industries. On Tuesday afternoon, beginning at 2.30 p.m., they would hope to take up the Cotton Industry. On Wednesday morning, it was proposed to deal with the Rubber Industry and to follow with Agricultural Credit and Loan Banks. On Thursday morning they would hold their last sitting, when there would be a general discussion on the results of the Conference. He would urge the regular attendance of the representatives during the sitting of the Conference in order to deal adequately with the business to be brought before it.

The Conference then adjourned for luncheon.

The Conference re-assembled at 2.45 p.m.

The PRESIDENT: Before beginning business this afternoon, I have been asked to place before you a Resolution to the following effect:—

'We, the members of the West Indian Agricultural Conference assembled at Jamaica, desire to express our humble loyalty to Your Majesty's person and Throne and the hope that during Your Majesty's reign the West Indian Colonies may again be amongst the most prosperous of Your Majesty's dominions.'

I would invite the Hon. F. J. Clarke, to move that Resolution.

The Hon. F. J. CLARKE (Barbados): I feel a great honour has been conferred on me in being asked to propose this Address of Loyalty to His Majesty the King. The people in these colonies have always been noted for their loyalty to the Throne in times of prosperity and adversity, and it is very fitting that at this Agricultural Conference, at which representatives from all the colonies in these parts are present, we should express our sentiments of loyalty. Some of these colonies have been under English rule since their settlement, some have been acquired by conquest, and some by treaty; they have seen days of great prosperity; they have seen days of great adversity. But in one respect there has been no change, and that is in their loyalty to the person and Throne of their Sovereign. (Cheers.) There is a story to the effect that when King Charles was in trouble with his Parliament, the people of Barbados passed an Address of Loyalty, and they concluded with the assurance that His Majesty need

not make himself uneasy as to the doings of Parliament, as they were quite prepared to stand by His Majesty, and to see him through his trouble. (Cheers.) I have great pleasure in moving this Address, and I hope that this Conference which is now sitting may assist in restoring again the prosperity which once reigned in this part of His Majesty's dominions (Applause.)

The Hon. B. HOWELL JONES (British Guiana): I have very great pleasure in seconding the motion proposed by Mr. Clarke. It requires no words from me to endorse all that he has said. It will be taking up too much of the time of the Conference if I attempted to give any historical account of the loyalty which has been shown, and how in the late war in South Africa the colonies volunteered to send representatives to the front to fight Britain's enemies.

The Resolution was put and carried with applause.

The PRESIDENT: There is a further Resolution to be submitted to you, which is as follows:—

'We, the members of the West Indian Agricultural Conference assembled in Jamaica, desire to express our deep appreciation of the action taken by His Majesty's Government in proposing to continue the valuable work of the Imperial Department of Agriculture in the West Indian Colonies, which they regard as essential to the future well being and prosperity of this portion of His Majesty's dominions.'

The Hon. R. CRAIG (Jamaica): I have great pleasure in asking the Conference to accept this Resolution. I feel that after what has been so very ably said this morning, it requires no words of mine to make it acceptable to you.

The Hon. CARL DE VERTEUIL (Trinidad) had great pleasure in seconding the Resolution, which was carried unanimously.

PROCEEDINGS OF CONFERENCE.

The regular business of the Conference was then proceeded with, and the papers and discussions on results of experiments in connexion with the Sugar Industry were opened by a Paper read by the Hon. H. H. Cousins, M.A., on 'Seedling Canes at Jamaica.' This was followed by a paper read by the Hon. Francis Watts, C.M.G., D.Sc., on 'Sugar-cane experiments in the Leeward Islands,' and then Mr. J. R. Bovell, F.C.S., F.L.S., proceeded with a paper on 'Sugar-cane experiments at Barbados.' It was during the reading of this paper that the disastrous earthquake, that caused considerable ruin in Kingston and its environs, took place, and the Conference was consequently adjourned.

The Conference was resumed on board the 'Port Kingston' on Saturday, January 19, during the return journey to Barbados, when particulars were given of the Cotton Industry in the various West India Islands by the Hon. Francis Watts, Mr. J. R. Bovell, and Mr. W. N. Sands.

WEST INDIAN AGRICULTURAL CONFERENCE, 1907.

(CONTINUED.)

In the previous pages a brief account of the Proceedings of the Conference has been given. It is now proposed to publish in full the principal papers in the order in which they have been submitted :—

SUGAR INDUSTRY.

SEEDLING CANES IN JAMAICA.

BY THE HON. H. H. COUSINS, M.A., F.C.S.,

Government Analytical and Agricultural Chemist, Jamaica.

The oldest variety of cane grown in Jamaica appears to be the dark cane which is still to be found on the ratooning estates on the northside of the island, and remains a popular variety with the small settlers. The Bourbon and Otaheite canes were introduced in 1796, the latter by Captain Bligh, while the former is supposed to have been brought from Trinidad. Until quite recently, the canes grown on sugar estates in Jamaica were practically limited to the White Transparent or Mont Blanc cane (which would appear to be identical with the so-called Otaheite cane introduced by Captain Bligh), the Bourbon or White cane, and the Creole or Ribbon cane. The Mont Blanc has made the most headway, and may now be taken as the standard cane for Jamaica, while the Bourbon is limited to a few upland estates, and the Creole cane is gradually being replaced by the Mont Blanc on the ratooning estates.

Previous to the first introduction of seedling canes by Messrs. Harrison and Bovell, the Department of Public Gardens in Jamaica had obtained a good number of cane varieties from other parts of the world. Mention might be made of the Selangor cane obtained from Martinique in 1871, and of the importation of a collection of varieties from Mauritius in 1882. In his Annual Report for 1883, Sir Daniel Morris, as Director of Public Gardens, reported sixty varieties as being under trial at Hope.

Many of these canes were distributed to estates, but none proved of real value, and planters were compelled to admit that the foreign canes were inferior to those at present being cultivated in the island.

In 1892, tops of the new seedling canes were obtained from Demerara and these were distributed to estates. Of these, D. 95 proved the most popular, and this cane has been grown on a fair scale on several estates. Experience has

shown that it does best on light soils with irrigation, and D. 95 has yielded remarkable returns on such estates as Albion and Mona under these conditions. Where the drainage is in any way deficient, D. 95 is a failure, and it has not proved itself to be a cane suitable for the majority of sugar estates in the island.

In 1899, tops of the promising Barbados seedling B. 147 were imported, and when a stock was obtained at Hope Gardens, it was distributed in fair quantities to estates. On the whole, B.147 has nôt proved itself an all-round cane in Jamaica, although mention should be made of its proved drought-resisting powers in the trials in Trelawney, where it stood out as the finest cane under these conditions.

In 1901, a stock of the Barbados seedling B. 208 was obtained from the Imperial Department of Agriculture, and this bids fair to prove the most valuable cane yet introduced into Jamaica.

Before the operations of the Sugar Experiment Station, the seedlings sent out from Hope were left entirely to the unassisted control of the estates, with the natural result that the varieties became mixed, and an interesting collection of cane varieties was frequently treated as one single seedling cane. In the absence of all accurate field and chemical control, it is not surprising that the wrong varieties were frequently selected for propagation before their imperfections were established. Until quite recently, the name 'D. 95' was on many estates applied to any seedling cane quite irrespective of its original and proper name. Some of these so-called 'D. 95' seedlings have achieved a local fame, and it is still necessary to see a 'D. 95' cane growing on a Jamaica estate before it can be accepted as the true sort. In 1901, I visited an estate where 50 acres of 'D. 95,' were claimed to be growing. Examination showed that there were at least eight or nine different varieties masquerading under this title, and I failed to find a stool of the genuine variety.

In 1902, systematic work in the selection of seedling cane varieties was commenced by a trial of some 100 varieties at Hope for preliminary selection, and, with the new machinery created by the founding of the Sugar Experiment Station in 1904, it has been possible to carry on systematic trials and selections at Hope, and gradually to extend the most promising varieties to estate trials under the guidance of the station.

Of cane varieties recently obtained from the Director of Science and Agriculture in British Guiana, D. 625 appears to be a cane of great promise, and it is being propagated at Hope as fast as possible so as to obtain a good supply for distributing to estates.

Over 100,000 tops were distributed from the Sugar Experiment Station at Hope during the past year, and nearly every estate in the island has received stock of the best canes for trial.

At first we had great difficulty in securing the delivery of the tops and cuttings in good condition, but by the use of

sacks, instead of barrels, a great improvement has been effected in this respect.

The safe transit of cuttings has been found so variable that our distribution is now limited to tops only, unless cuttings are particularly asked for.

We are now raising 3,000 seedlings each year, and some of the finest seedlings show good promise. Next year the best of these will be tested on estates in the different sugar districts of the island.

The great increase in the spread of this work has been made possible by the appointment of a Superintendent of Field Experiments, and it is now apparent that the value of seedling canes is being tested under reasonably reliable conditions all over the island.

SUGAR-CANE EXPERIMENTS IN THE LEEWARD ISLANDS.

BY THE HON. FRANCIS WATTS, C.M.G., D.Sc., F.I.C., F.C.S.,

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It has already been explained on several occasions that the sugar-cane experiments in the Leeward Islands fall into two categories—the experimental cultivation of new varieties of canes in order to ascertain which canes are likely to prove most useful and profitable, and experiments with various forms of manures and manurial treatment to obtain information for the guidance of planters in the treatment of their crops; comparatively little work having been done in raising new canes from seed.

At the last Conference, held at Trinidad in January 1905, an account was given of the manner in which the experiments had been conducted, and of the principal results which had been obtained. Since that time the work has been continued and advantage may be taken of this present Conference to place on record what has been done in the interim and to indicate, briefly, the lines on which it is thought desirable that future investigations should be carried on.

EXPERIMENTS WITH VARIETIES OF SUGAR-CANES.

Although the fact has been referred to on many occasions, it is necessary to state that in the first instance, interest in new varieties of sugar-cane arose chiefly from the disastrous prevalence of diseases amongst the canes grown in the Leeward Islands, so that planters were impelled to seek for new varieties in an effort to save their most seriously threatened

industry, immunity from disease being of more immediate and pressing importance than the questions of quality and increased saccharine richness. How acute the trouble was, may be gathered from the fact that the quantity of sugar produced in Antigua during the crop of 1895 was only 6,685 tons, whereas the average annual output for the previous fourteen years was 13,113 tons. The critical period for St. Kitt's-Nevis came five years later than for Antigua, when, in the year 1900, the export of sugar from St. Kitt's-Nevis fell to 7,495 tons, the average for the previous nineteen years being 15,365 tons. Under these circumstances, freedom from disease was the point to which the planter attached most importance.

Fortunately, the work of the Experiment Stations had arrived at a point where relatively immune and valuable canes could be provided in substitution for the disease-stricken kinds then employed. Some little time was necessarily occupied in effecting the substitution, but in the end it was practically complete, and with the most satisfactory result, so that at the present moment sugar-cane diseases cause the planter in the Leeward Islands comparatively little anxiety, too little anxiety I am inclined to think, for I believe the position would be a safer one, were he to give the subject such careful and constant consideration that there may be no risk of unobserved diseases invading the cane-fields and establishing themselves before the planter is aware of their existence.

Since the substitution of healthy for diseased canes, the interest in varieties has naturally gravitated in the direction of ascertaining the richest and most vigorous cane for cultivation under the varied conditions of soil and climate obtaining on the various sugar estates. These variations are such that each planter may find that it is necessary, or at least advisable, for him to follow the experiments closely and make such a selection of canes as will suit the peculiar circumstances of the estate in which he is interested. The manner in which the experiments have been conducted has been devised largely with this object in view.

The experiments consist in the planting of a number of selected varieties in fields in the course of ordinary cultivation in sugar-cane; the planting is superintended by an officer of the Department of Agriculture, and the cultivation of the experiment plot is carried on concurrently with that of the rest of the field, of which the experiment plot forms a normal part. The plots are indicated by the labels employed for the different varieties of cane. This goes on until the canes are ready for reaping, when the Department of Agriculture superintends the cutting and weighing of the canes under experiment, at the same time taking samples for crushing in a small mill in order to ascertain various necessary facts concerning the quantity and quality of the juice afforded by the canes of all the plots when tested under uniform conditions.

In all this work the co-operation of the planters themselves is earnestly sought. In many instances, this is willingly and intelligently given; sometimes, however, instances are met with in which subordinate officers of sugar estates feel that

the experiments impose extra duties in which they, individually, have little interest. The work of conducting experiments would be lightened and the results be made more usefully applicable, if the owners and attorneys of estates would encourage employees to take a lively interest in the work, and were to lay stress on the desirability of having the experiments carefully attended to, so that an intelligent statement of the results could be given at any moment for the guidance of affairs on the estate. I should like it to be felt in every instance that the work of experiment is an *estate duty* aided by the Department of Agriculture, rather than a *Department of Agriculture duty* aided by the estate.

In the ordinary course of these experiments, we have in each year 760 plots of varieties of canes in Antigua and 360 in St. Kitt's, a total of considerably over 1,000 experiments in this direction alone. These are arranged at eight stations in Antigua and seven stations in St. Kitt's. There are also additional experiments with canes not introduced into general distribution.

Owing largely to climatic conditions, it has not been found possible to raise many new seedling canes at Antigua, and but little has been done in this connexion at St. Kitt's; the work of experiment has, therefore, largely consisted in cultivating selected varieties which have been supplied from other places, and in this particular we are most largely indebted to Barbados and British Guiana.

During the years in which these experiments have been carried on, a large number of canes have been experimented with; many of these have been discarded, and experiments with them discontinued, owing to the substitution of other and better canes. The position may be indicated by statements taken from the report of last season's work, now in the press. *

At Antigua, twenty-one varieties were distributed for experimental cultivation, as plant canes, each in duplicate at eight stations. The average results obtained are shown in Table I.

In dealing with these results it must be remembered that the season was one of disastrous drought, during which the sugar production of the whole island, and consequently of the experiment plots, was reduced far below the normal. The figures have, however, considerable comparative value.

Some sixteen varieties have been under experimental cultivation as plant canes on a large number of plots during five years: it is interesting to take the average results obtained during that period in the case of each cane: the results are given in Table II.

As some of the most promising canes have not been under experimental cultivation at Antigua for so long a time as five years, they are not referred to in the last table; amongst those so excluded are D. 625, D. 109, B. 393, and B. 376.

* Since published as 'Sugar-cane experiments in the Leeward Islands, for 1905-6, Part I, and Pamphlet 46, by the Imperial Department of Agriculture.

TABLE I.
ANTIGUA.—PLANT CANES.
Means deduced from 14 plots of each variety of Cane.

No.	Name of Cane.	CANE. Tons per acre.	JUICE. Gallons per acre.	JUICE. Gallons per ton.	SUCROSE. Pounds per gallon of Juice.	SUCROSE. Pounds per acre in Juice.
1	D. 625 ('G.')*	28·3	3,337	117·9	1·931	6,516
2	B. 156	25·7	2,888	112·4	1·919	5,544
3	D. 109	22·9	2,593	113·2	2·060	5,187
4	Sealy Seedling	22·4	2,570	114·7	2·016	5,111
5	B. 208	20·4	2,249	110·3	2·114	4,664
6	Queensland Creole †	21·1	2,291	108·6	2·036	4,580
7	B. 393	18·0	2,097	116·5	2·147	4,479
8	B. 376	20·8	2,201	105·8	2·003	4,396
9	Mont Blanc	19·4	2,147	110·7	2·046	4,233
10	Burke	19·8	2,152	108·7	2·008	4,226
11	B. 306	18·0	2,118	117·7	2·028	4,150
12	D. 74	18·9	2,243	118·7	1·912	4,097
13	B. 109	17·9	2,024	113·1	2·073	4,086
14	D. 99 ††	18·3	2,084	113·9	2·055	4,059
15	Red Ribbon	18·2	2,038	112·0	2·058	4,038
16	D 116	19·0	2,174	114·4	1·860	3,938
17	White Transparent†	17·6	1,928	109·5	2·093	3,882
18	B. 147**	16·5	1,948	118·1	2·005	3,831
19	T. 211 †††	16·5	1,916	116·1	2·151	3,745
20	D. 115	16·4	1,803	110·0	1·932	3,430
21	D. 95**	13·4	1,542	115·0	2·089	3,111
22	D. 130	14·4	1,453	100·9	1·950	3,045

* Mean of 8 plots only.
** ,, ,, 12 ,, ,,
† ,, ,, 13 ,, ,,
†† Mean of 10 plots only.
††† ,, ,, 7 ,, ,,

TABLE II.

ANTIGUA.—PLANT CANES.

Means for five years.—Deduced from 74 plots of each variety of Cane.

No.	Name of Cane.	Means of sucrose in pounds per acre for five years.
1	B. 208*	8,437
2	B. 156*	8,080
3	Sealy Seedling*	7,869
4	B. 306†	7,582
5	B. 109††	7,393
6	D. 95††	7,250
7	D. 74	6,918
8	D. 130†	6,906
9	Mont Blanc†	6,650
10	White Transparent*... ...	6,490
11	Burke†	6,334
12	Red Ribbon††...	6,322
13	D. 116	6,280
14	Queensland Creole**	6,193
15	D. 115†	5,881
16	B. 147‡‡	5,740

* Mean of 72 plots only.
** ,, ,, 69 ,, ,,
† ,, ,, 71 ,, ,,
†† Mean of 71 plots only.
‡‡ ,, ,, 70 ,, ,,

TABLE III.

ANTIGUA.- RATOON CANES.

Means deduced from 16 plots of each variety of Cane.

No	Name of Cane.	CANE. Tons per acre.	JUICE. Gallons per acre.	JUICE. Gallons per ton.	SUCROSE. Pounds per gallon of Juice.	SUCROSE. Pounds per acre in Juice.
	D. 109*	16·6	1,900	114 5	1·994	3,789
	Sealy Seedling	14·8	1,698	114·7	1·947	3,307
	B. 306†	12·4	1,445	116·5	1 990	2,876
	D 95	11 8	1,363	115·5	2·076	2,830
	B. 147†	12 6	1,461	116·0	1 924	2,811
	B. 156	13·3	1,433	107 8	1 934	2,772
	Mont Blanc	11·4	1,257	110 5	2·186	2,748
	B. 376 .	12 2	1,305	107 0	2·060	2,688
	Burke†	11 4	1,222	107·2	2·101	2,567
10	B. 393†	11 5	1,292	112 4	1·986	2,566
11	D. 74	11 7	1,328	113 5	1 898	2,521
12	Red Ribbon	11 2	1,207	107 8	2 050	2,475
13	White Transparent†	10·9	1,167	107·1	2 105	2,456
14	B. 208 .	10·0	1,138	113·8	2·085	2,373
15	D. 116 .. .	11·1	1,243	112 0	1·895	2,355
16	Queensland Creole	11 0	1,135	103 2	2·070	2,349
17	D. 99*	13·4	1,535	114·6	1·502	2,305
18	B. 109†† ...	10 0	1,101	110 1	1·985	2,185
19	D. 115†	9·9	1,098	110 9	1 912	2,099
20	D. 130	8·6	952	110 7	1·947	1,801

* Means of 13 plots only † Means of 15 plots only †† Means of 14 plots only.

TABLE IV.

ANTIGUA.—RATOON CANES.

Means for four years.—Deduced from 53 plots of each variety of Cane.

No.	Name of Cane.	Means of sucrose in pounds per acre for four years.
1	Sealy Seedling	4,752
2	B. 306** ..	4,500
3	B. 109** . ..	4,293
4	D. 95	4,248
5	B. 208	4,208
6	B. 156‡	4,153
7	Mont Blanc	3,891
8	D. 130†	3,821
9	D. 74	3,815
10	Burke‡	3,770
11	B. 147**	3,761
12	White Transparent.	3,743
13	D. 116	3,624
14	D. 115*	3,537
15	Queensland Creole	3,385
16	Red Ribbon . ..	3,266

After the reaping of the plant canes, work is continued on the plots, so that first ratoons are grown and reaped under experimental conditions. The results obtained last season are set forth in Table III.

A number of canes have been under experimental cultivation as ratoons for several years. Table IV gives the mean results in connexion with sixteen varieties during four years.

As a result of these experiments, certain selected canes are attracting the attention of planters who are extending the experiments by cultivating these canes on moderate-sized plots with the intention of introducing into general cultivation, such as their observations lead them to consider suitable. This particular phase of the work is important and valuable, and I should be glad to render assistance in developing this work on definite lines, and placing the results on record.

The canes attracting most attention at Antigua are B. 208, B. 147, B. 156, B. 376, B. 398, B. 306, Sealy Seedling, D. 625, D. 95, D. 74, and D. 109.

* Means of 49 plots only. † Means of 50 plots only.
** " " 51 " " ‡ " " 52 " "

The work at St. Kitt's has been conducted on similar lines. The results obtained last season in reaping the plant canes were :--

TABLE V.

ST. KITT'S.—PLANT CANES.

Means deduced from 8 plots of each variety of Cane.

No.	Name of Cane.	CANE. Tons per acre.	JUICE. Gallons per acre.	JUICE. Gallons per ton.	SUCROSE. Pounds per gallon of Juice.	SUCROSE. Pounds per acre in Juice.
1	B. 254 . .	32·6	4,102	128·6	1·926	8,072
2	B. 208 ..	27·9	3,629	130·1	2·188	7,939
3	Sealy Seedling* .	33·4	4,321	129·5	1·805	7,803
4	D. 116	32·0	4,185	130·8	1·822	7,625
5	Striped Singapore	29·3	3,799	129·7	1·939	7,367
6	D. 130* . .	28·4	3,641	128·2	1·874	6,824
7	D. 109*	29·4	3,301	112·3	2·059	6,796
8	Mont Blanc . .	27·6	3,620	131·2	1·868	6,760
9	D. 74	28·6	3,744	130·9	1·787	6,689
10	Queensland Creole ...	26·6	3,367	126·6	1·960	6,598
11	B. 376	27·3	3,499	128·2	1·850	6,473
12	White Transparent ...	27·0	3,397	125·8	1·882	6,391
13	B. 306	23·6	3,271	138·6	1·914	6,261
14	Burke	24·5	3,143	128·3	1·952	6,134
15	D. 95	20·8	2,780	133·7	2·016	5,604
16	B. 393	22·0	2,860	130·0	1·956	5,595
17	B. 147	21·9	2,662	121·6	2·056	5,472
18	Rock Hall . .	22·9	3,046	133·0	1·786	5,441
19	B. 109 . ..	23·5	3,126	133·0	1·651	5,162
20	B. 156	21·6	2,890	133·8	1·715	4,955

* Means of 7 plots only.

The results obtained in the experimental cultivation of sixteen varieties as plant canes during six years are as follows:—

TABLE VI.

ST. KITT'S.—PLANT CANES.

Means for six years.—Deduced from 45 plots of each variety of Cane.

No.	Name of Cane.	Means of sucrose in pounds per acre for six years.
1	B. 208	8,544
2	D. 116	7,671
3	Mont Blanc† . ..	7,441
4	D. 74	7,350
5	B. 376†	7,118
6	Queensland Creole*	7,088
7	B. 306	7,058
8	White Transparent	6,948
9	B. 393	6,923
10	B. 147	6,838
11	B. 109	6,683
12	D. 95	6,675
13	Striped Singapore**	6,661
14	B. 254†	6,640
15	Rock Hall††	4,999

The results obtained from the ratoon canes in the last season, and from the cultivation of seventeen varieties during five years are given in Tables VII and VIII:—

* Means of 43 plots only. ** Means of 29 plots only (four years).
† ,, ,, 44 ,, ,, †† ,, ,, 28 ,, ,, ,, ,,

Table VII.

ST. KITT'S.—RATOON CANES.

Means deduced from 6 plots of each variety of Cane.

No.	Name of Cane.	CANE. Tons per acre.	JUICE. Gallons per acre.	JUICE. Gallons per ton.	SUCROSE. Pounds per gallon of Juice.	SUCROSE. Pounds per acre in Juice.
1	Jamaica*	23·5	3,037	129·2	2·063	6,265
2	D. 95	22·8	2,977	130·6	2·091	6,224
3	D. 74	24·0	3,085	128·6	1·967	6,068
4	Rappoe*	23·4	3,023	129·2	2·002	6,051
5	White Transparent... ...	23·6	3,051	129·3	1·959	5,977
6	D. 116	24·8	3,264	131·6	1·818	5,923
7	B. 109	25·8	3,343	129·6	1·766	5,903
8	B. 147	22·8	3,001	131·6	1·929	5,789
9	B. 376*	23·8	3,017	126·8	1·847	5,572
10	Queensland Creole†	21·9	2,724	124·4	2·032	5,536
11	D. 115	22·0	2,813	127·9	1·925	5,415
12	Caledonian Queen††	22·5	2,763	122·8	1·953	5,397
13	B. 306	20·3	2,716	133·8	1·962	5,330
14	B. 208	18·7	2,475	132·4	2·093	5,179
15	Striped Singapore†† ..	20·9	2,587	123·8	1·991	5,151
16	Mont Blanc*	19·8	2,547	128·6	1·968	5,013
17	B. 393	19·0	2,440	128·4	2·007	4,897
18	B. 254†	19·4	2,465	127·1	1·956	4,811
19	Naga B.*	17·3	2,127	123·0	1·961	4,171
20	Rock Hall††	17·0	2,209	130·0	1·847	4,079
21	D. 145††	15·4	2,024	131·4	1·621	3,281

* Means of 4 plots only. † Means of 5 plots only. †† Means of 3 plots only.

TABLE VIII.

ST. KITT'S.—RATOON CANES

Means for five years—Deduced from 29 plots of each variety of Cane.

No.	Name of Cane	Means of sucrose in pounds per acre for five years
1	B. 306 .	6,362
2	D. 95	6,353
3	B. 208	6,344
4	D. 115	6,333
5	Jamaica*	6,101
6	B. 147	6,094
7	D 74	6,049
8	D. 116	5,891
9	White Transparent	5,885
10	Naga B	5,770
11	Rappoe*	5,627
12	B. 376*	5,562
13	Mont Blanc*	5,546
14	B. 109	5,537
15	Queensland Creole†	5,361
16	B. 393	5,324
17	B. 254† ..	5,039

The principal canes under consideration in St. Kitt's are B. 147, B. 208, B. 156, B. 254, Sealy Seedling, D 109, D. 116, and D. 130.

Means of 27 plots only.
† " " 28 " "

INTRODUCTION OF NEW VARIETIES INTO GENERAL CULTIVATION.

It is interesting and important to ascertain to what extent the newly introduced varieties have taken the place of the varieties formerly cultivated in these islands. In a general way, the substitution may be described as complete. At Antigua, up to about the year 1896, the Bourbon cane was practically the only variety under cultivation ; a few other canes were to be found in the fields, but they were not separately and systematically cultivated.

The present position is clearly shown by a return of the canes now growing on 8,879½ acres, or about three-fourths of the area under canes. This is as follows :—

White Transparent	... 6,787	acres.	
B. 208	... 332	"	Being increased.
B. 147	... 297	"	Being largely increased.
Sealy Seedling	... 246½	"	Appreciated on poor soils.
Bourbon	... 190	"	Formerly the only cane grown.
D. 95	... 177½	"	
Mont Blanc	... 137½	"	(Practically identical with White Transparent.)
Naga B.	... 115	"	"
B. 306	... 125½	"	
B. 109	... 65½	"	
Uba	... 20	"	
B. 156	... 8½	"	
D. 115	... 2	"	
B. 376	... 1	"	
B. 109	... ½	"	
D. 116	... ½	"	
Mixed varieties	... 373	"	
Total	... 8,879½	acres.	

In dealing with the foregoing list it is to be remembered that the White Transparent cane was the one introduced when the Bourbon fell a prey to disease. It is regarded in Antigua as a 'new variety' and, being recently introduced into general cultivation, there has been little disposition to make further changes, except in a tentative manner, at so early a stage. The real position and the extent of the change can best be measured by having regard to the small quantity of Bourbon cane now cultivated. Evidence is not wanting that, in a few years, the White Transparent variety will give place to others.

The substitution of new varieties for old has been almost as complete in St. Kitt's, though here the story has been somewhat different. The acute crisis due to the overwhelming presence of disease amongst the canes did not reach St. Kitt's until several years later than Antigua ; the critical year was 1900, when the export of sugar fell to one-half the normal quantity. At that time the variety most largely grown was the White Transparent;

there was also a considerable quantity of Bourbon ; both these varieties were badly stricken by disease Energetic steps were taken to substitute other varieties. In these efforts B. 147 was selected as the most suitable cane, so that the bulk of the sugar exported during the last two or three years has been derived from that cane. Many interesting stories are told of the apparent ruin of some estates by the ravages of disease and of their being rapidly restored to a condition of productiveness in excess of that formerly enjoyed owing to the introduction of the cane B. 147, which is now deservedly held in high estimation. It may be estimated that some 2,500 acres are at present under cultivation.

This variety is late in maturing and is liable to retard the reaping of the crop and thus disarrange the work of the estate This objection has additional weight now that it has been found that, owing to the peculiar condition of the soil of St. Kitt's, it is possible to grow a good crop of cotton as an interim crop in the cane fields between May and December, while otherwise the land would be lying fallow waiting for the cane crop. This practice has somewhat delayed the planting of the canes —a matter of disadvantage where B. 147 is concerned. As a consequence of this, additional attention has been given to the cane B. 208, which matures somewhat quickly. This cane has been found to thrive under the conditions of soil and climate obtaining at St. Kitt's, so that the area under cultivation is rapidly increasing ; at the present moment it is estimated to be about 500 acres. Of the White Transparent there are 4,500 acres ; of other seedlings, 500 acres ; and of Bourbon, 50 acres.

Other varieties are being grown on a smaller scale, and the cultivation of the best of these is extended as the planters find them suitable for their requirements. Amongst these, reference may be made to D. 116, which is growing in favour, while B. 109, after trial in a moderate degree, is being discarded.

It is not easy to place a monetary value on the advantages which have followed the introduction of new varieties of canes. The position may, perhaps, best be summed up in the statement that the survival of the industry is due to the introduction of these new varieties ; but for this, it appears reasonably safe to assert, the industry was in danger of speedy extinction. With these facts before them, the planters are quite alive to the importance of the work, and are appreciative of the value it has been to the colony. The work of fighting disease, for the present, having been successful, more attention is being given to the other phase of the work connected with the introduction of new varieties of canes, namely, the possibility of increasing the yield of sugar, and this is the side of the work which will command increasing attention in the immediate future.

If we take the exports of sugar from Antigua and St. Kitt's at, very approximately, 25,000 tons, worth £200,000, and assume that the industry has only been benefited to the extent of 10 per cent. (an amount which will seem moderate to those who experienced the ravages of disease), this would give the very rough approximation of £20,000 a year as the value of the

introduction of new varieties of canes—a sum in excess of that spent in maintaining the Imperial Department of Agriculture in its entirety. It is right and desirable that commutations of this kind, even of the rough character here given, should be made in order to bring home to those interested the magnitude of the interests involved.

PRESENT POSITION OF SUGAR-CANE DISEASES IN ANTIGUA.

Seeing that some ten years ago sugar-cane diseases were so rife as to threaten the very existence of the sugar industry, and seeing that the steps taken to improve the position appear to have reduced the amount of the disease in a very marked degree, it seemed desirable to ascertain from the planters themselves their views as to the present prevalence of diseases, and thus learn whether there exists, so far as they are able to ascertain, any cause for alarm in the near future. With this in view I caused a circular to be issued in May 1906, directing attention to the principal diseases, and inviting planters to give the results of their observations during the immediate past. The object of the inquiry was two-fold: to ascertain whether, in the opinion of the planters themselves, there is any appreciable amount of disease now present in the canes and whether this is increasing, and also to arouse a lively and critical interest in the subject of cane diseases so as to prevent any insidious attack of disease obtaining a foothold before general attention is called to it.

The following remarks, taken from the Report on Sugar-cane Experiments in the Leeward Islands for the year 1905-6, Part I, will serve to sum up the position:—

In only four out of twenty-eight replies is it suggested that there is any appreciable amount of disease present this season; the other twenty-four replies are to the effect that there is no appreciable amount of disease. Of the two who report an appreciable amount of disease, one observer says that there is not very much, while the other says it is confined to small patches. Another reports a little root disease, while the fourth refers to injuries from insect pests.

The replies are almost unanimous in stating that disease is less prevalent than during the past five years. One observer says he thinks that in his district diseases are slightly more prevalent than last year, while another expresses the belief that the moth borer is increasing.

The replies are conclusive evidence that the planters themselves regard their canes as reasonably free from disease, and that they think diseases are less prevalent than during the past five years; even those who do not expressly agree with these two statements only refer to small amounts of disease. This is important evidence and satisfactory as far as it goes, but it is hoped that planters will not thereby be lulled into a false sense of security, but rather be stimulated to further, more critical, and more systematic observation during the coming season.

As planters find so little evidence of disease, not many points of importance are brought forward respecting the diseases themselves. There are several references to the existence of small amounts of root fungus and a smaller number to small amounts of rind fungus.

Several observers express the opinion that diseases (presumably fungoid diseases) are more prevalent where the soil conditions are unfavourable; for example, upon heavy, badly drained clay soils or upon thin, dry soils on hillsides. The suggestion is put forward that plant canes are more attacked by rind fungus, and ratoon canes by root fungus. It is admitted by many that the Bourbon cane is so liable to attacks of rind fungus that it can no longer be profitably grown. Several allusions are made to small amounts of disease in the White Transparent cane. This disease would appear chiefly to be root fungus. This is somewhat significant, and planters should keep a careful watch upon this widely cultivated variety.

Two references are made to the prevalence of moth borer in B. 208, and in one case the Uba cane is referred to as badly attacked by this pest.

There are many references to B. 147, as showing considerable resistance to disease. It appears to offer resistance to root fungus—a point of some importance. The manager of Gunthorpe's factory states his impression that the following canes show freedom from disease in the order named: B.147, Sealy Seedling, B. 208, B. 109, D. 95. His observations are confirmed in a general manner by several observers.

From the inquiry, we gather that the planters themselves are of opinion that no serious amount of disease exists amongst their canes at the present time, and that, on the whole, the amount is less than it was during the last five years—a statement of very considerable importance.

Dealing with the kind of canes grown, it is admitted that the Bourbon is so badly attacked by disease as to be unprofitable. White Transparent is showing some signs of attack, chiefly of root fungus. As a variety resistant to diseases, B. 147 is well spoken of, and so are Sealy Seedling, B. 109, and D. 95.

These points, I think, sum up the principal views of the leading planters, who, I believe, hold the opinion that there is no immediate cause for anxiety in the matter of cane diseases, but they recognize that constant vigilance is necessary.

On the whole, I concur in these views; but I am inclined to think that the insidious nature of the attack in the cases of root fungus leads planters very frequently to overlook its existence except in bad cases. Very often the crop may be seriously lessened by the presence of root fungus without any appreciable amount of dead cane being seen. As is now known, the root fungus attacks the tips of the roots, and by destroying them prevents the cane obtaining a full supply of moisture from the soil, hence there is often confusion between the effect of drought and the effect of root fungus. My own observations lead me to

think that root fungus is more widely distributed than planters imagine, and I would urge their very careful attention to this point.

The remedies for root fungus appear to be the planting of other crops than cane for a year or two. Cotton makes an excellent rotation crop in this respect. There are at the present moment several good illustrations of this, where canes are now growing vigorously after a crop of cotton in localities previously badly effected by root fungus. In the replies to questions under consideration, one planter directed attention to good results in combating root fungus by growing sweet potatos as a rotation crop. In addition to rotation of crops, a further means of combating the disease lies in the selection of resistant varieties of cane. Of these, B. 147, Sealy Seedling, B. 208, B. 109, and D. 95 are favourably spoken of.

MANURIAL EXPERIMENTS.

In the year 1900, in extension of work previously done, a series of experiments, calculated to ascertain the effect of various manures and combinations of manures, was instituted with plant canes. This series consisted of thirty-three experiments each repeated on several plots in each season: the plots were laid out on three estates in Antigua and two in St. Kitt's, a duplicate series being conducted at each estate. In this manner some 1,980 manurial experiments with plant canes have been conducted during the six years that this series has been in operation. The results of these experiments are now in the press (Sugar-cane Experiments in the Leeward Islands for the year 1905-6, Part II).

Briefly expressed, the conclusions arrived at are that, under the conditions of soil and climate obtaining in the Leeward Islands, it is not necessary or remunerative to use artificial manures for plant canes, when the canes are grown upon land properly tilled and manured with about 20 tons per acre of good pen manure, or its equivalent.

It is generally recognized that the liberal use of pen manure or similar material is essential to the maintenance of the proper condition of the soil as regards tilth, and that with the use of, artificial manures alone without pen manure or organic manure in some form it will be difficult to maintain the soil in a fertile and productive condition. This being so, it would appear that the planter is provided with a complete answer to those questions which have arisen respecting the proper manuring of plant canes which these experiments were designed to answer. It is therefore proposed to discontinue this particular line of investigation and to devote the time and energy to other kindred inquiries.

Before leaving this part of the inquiry, it is interesting to observe that these results appear, from what we have recently heard, to be more in accord with the results obtained at Barbados than has hitherto been supposed. In both cases the use of phosphate in the form of artificial manure for plant cane is not recommended, a sufficient quantity of this constituent being

conveyed to the soil in the pen manure employed; the use of potash does not appear to be of great importance: some benefit and profit appear to result from its use at Barbados, but practically little or none in the Leeward Islands. Different results, however, attach to the use of nitrogen. In the Leeward Islands, the pen manure appears to supply sufficient; in Barbados, this is not the case, and the use of nitrogenous manures in addition to pen manure is recommended. This difference is probably explained by the difference in the conditions of drainage in the several places. In Barbados the soil is somewhat thin and rests upon porous limestone; the result of this is that in heavy falls of rain a considerable quantity of water passes through the soil into the limestone and carries with it an appreciable quantity of nitrogen. It is on record that when heavy rain falls at a time when artificial manures are being applied to the cane fields, the amount of nitrogen in the well-water of the island is quite perceptibly increased. The conditions at Antigua are such that there is little or no subsoil drainage, consequently there is little or no loss of nitrogen from this cause. At St. Kitt's the soil is light with a porous subsoil: it appears probable that in this instance such water as reaches the subsoil may be stored there and may largely be returned to the surface by capillarity, as the surface dries; in this manner a large part of any nitrogen which may be washed into the subsoil may again be brought within the range of the roots of the canes.

Concurrently with the investigations with regard to manures and plant canes, investigations have been carried on in connexion with ratoon canes. These consisted in the application of a similar series of manures as had been applied to the plant canes to the plots from which the plant canes had been cut, and continuing the cultivation as ratoon canes. In this manner the work has been carried on for five years, during which time observations have been made on over 1,000 plots.

These observations, which are recorded in detail in the reports, show conclusively, that artificial manures are necessary for the successful cultivation of ratoon canes. Briefly stated, the conclusions arrived at are as follows.

Nitrogenous manure is essential to the successful growing of ratoon canes; it is best applied in some quick-acting form such as nitrate of soda or sulphate of ammonia; it should be applied at a fairly early stage of the growth of the cane and in one application; the effect of dividing the dose is to decrease the yield. From a pecuniary point of view it is better applied alone than in combination with phosphate and potash; the most remunerative amount to use would appear to be 40 lb. of nitrogen per acre; that is, about 200 lb. of sulphate of ammonia or 250 lb. of nitrate of soda.

Phosphatic manures appear to have little or no effect on the quantity of cane produced, while potash, applied in conjunction with nitrogen and phosphate, increases the quantity of cane by a small, but unremunerative amount.

Guano has been found to increase the yield slightly, but not in a remunerative degree.

These experiments have been conducted on plots to which artificial manures were applied to the plant canes. It has, however, been shown that artificial manures are not required for plant canes. It becomes necessary, therefore, to inquire what manures will be required when ratoons follow plant canes which received no artificial manures. It may possibly happen that the non-profitable results obtained with phosphate and potash may be due to the action of the residues of these manures when applied to plant canes masking the effect of that supplied to the ratoons. In order to investigate these problems, the former series of ratoon experiments has, therefore, now been brought to an end, and a new series substituted. In the new series work is carried on in connexion with ratoon canes arising from plant canes which received no other manure than pen manure or its equivalent.

Some work has already been accomplished in connexion with this new series of ratoon experiments. During the season 1904-5, two series of experiments were conducted, one at Antigua and the other at St. Kitt's. In the season 1905-6, the work was extended to six stations, five being in Antigua and one in St. Kitt's; the experiments are conducted in duplicate at each station.

Unfortunately, the work has been greatly interfered with by drought, so that no conclusive results can yet be put forward, beyond the generally accepted one, that manures of any kind are likely to prove unremunerative in very dry weather. So far, there is nothing to indicate that the results to be obtained in this series will materially differ from those already stated in connexion with ratoon canes.

It is proposed that the new series of manurial experiments shall be carried on for a number of years on as extended a scale as circumstances permit. If carried to a successful issue, it is felt that this series is calculated to supply answers to the most pressing problems connected with the manuring of sugar-canes with which the planter in the Leeward Islands is confronted.

APPENDIX.

PEN MANURE AND ALLIED MANURES.

The foregoing conclusions having emphasized the importance of pen manure in the preparation of the land for plant canes and having, moreover, shown that, without artificial manures, pen manure is sufficient for the growth of plant canes, it becomes desirable to devote increasing attention to the question of pen manure and its allies. Time may perhaps be afforded me for reading extracts from notes on this subject which appear in the Report for 1905-6.

The value of correct information concerning the use of manures may be thus brought home. Assuming that some

20,000 or 22,000 acres are under cane cultivation in the Leeward Islands and that acting under mistaken ideas artificial manures were to be used to one-third of this area at the rate of £2 per acre, this being about the area of plant canes and the value of manures which, following the methods of other countries might be advised, the loss might be some £14,000 a year, exclusive of losses from erroneous methods in connexion with the manuring.

Pen manure consists of the excreta of farm animals mingled with the bedding or litter of the animals, the whole being in a more or less rotted or decomposed condition. A curious fallacy exists in the minds of our older planters that manure contains more plant food material that the food and bedding from which it is derived; in other words, that the animals contribute something which makes the manure more valuable. It is not difficult to demonstrate that the manure really contains less plant food material than the food supplied to the animals, some portion being retained by the animals in building up its body, while other portions are lost or dissipated.

This being so, it holds good that the same amount of plant-food material may be conveyed to the soil by burying the grass, cane-tops, and other substances directly in the soil without submitting them to the action of the animal. But there is after all something in the above contention of the planter that the animal contributes in some way to the efficiency of manure. What is contributed is the modification of its condition, so that it becomes more readily assimilated with the soil and becomes available to the growing plant in a much shorter space of time --an item of considerable importance in practice.

The function of the animal is therefore evident. It is, however, worth while noting that the usefulness of the animal extends beyond the food actually eaten and voided. If, as is the custom here and elsewhere, animals are allowed to stand upon accumulations of litter and bedding until a thick layer of manure accumulates under them, the excreta of the animals hasten the decay of the litter and uneaten grass and bush, and bring the whole mass into condition as manure. This hastening of the decay is due in part to the moisture voided by the animals, in part to the alkalinity induced, and perhaps more particularly in part to bacteria from the intestinal tracts of the animals.

There is a tendency on the part of the planters to keep animals for the sake of 'making manure.' This is sound in principle, in that a certain number of animals are desirable for bringing the manure into good condition without loss of time, but it may be carried to excess : a limited number of animals will hasten the decay of much more material than they eat and thus may be employed to prepare large quantities of manure. One point has to be guarded against in practice : the attendants are disposed to give to the animals only as much material as will serve as food, whereas every effort should be made to give a very large excess, part to be eaten and the remainder to be rotted. In this way animals may be carefully kept 'to make manure.'

In procuring manure for sugar estates the greatest care should be taken to accumulate all available grass, bush, cane

tops, and vegetable matter of all descriptions which should be piled into compost heaps. In absence of animals, this, in process of time, will rot down and form useful manure equal in value to pen manure. Its decay may be promoted by judicious watering. It is advantageous to spread layers of earth at intervals through the compost heaps, for the earth absorbs valuable constituents which might otherwise be lost, and at the same time promotes decay.

If animals are available, the best results are obtained by combining the method of the compost heap with the feeding of the animals. This indeed is the local practice, though there may be some small misconception as to the function of the animals. If the part played by the animals is correctly understood and appreciated, it is probable that a larger quantity of manure will be produced under conditions of greater economy.

A number of the analyses of local pen manures have recently been made in order to ascertain what amount of plant food is conveyed to the soil by the usual application given in practice. From the figures given, it is readily seen that 20 tons of pen manure per acre will more than supply the quantities of potash, phosphate, and nitrogen required for a crop of 40-50 tons of cane per acre, taking the amounts required at potash 60 ℔., phosphoric acid 30 ℔., and nitrogen 70 ℔., as given by 120 ℔. of sulphate of potash, 200 ℔. of basic slag, and 350 ℔. of sulphate of ammonia.

The analysis of such things as bush, dagger leaves, and seaweed will also assist the planter to ascertain how much help he may expect to receive from the use of these and similar substances which hitherto have not received as much attention as their usefulness warrants.

ANALYSES OF PEN MANURES AND ALLIED MANURES.

									Pounds Per Ton of 2,240 Lb.						
	Water.	Organic matter.	Ash.	Total.	Phosphoric acid (P_2O_5).	Potash (K_2O).	Nitrogen.	= Ammonia (NH_3).	Water.	Organic matter.	Ash.	Phosphoric acid (P_2O_5).	Potash (K_2O).	Nitrogen.	= Ammonia (NH_3).
I ...	56·54	19·35	24·11	100·00	...	...	·23	·65	1,267·0	433·4	539·6	..	...	11·9	14·4
II ...	31·07	57·77	11·16	100·00	·30	·38	·58	·70	696·0	1,294·0	250·0	6·6	8·5	13·0	15·8
III ...	27·64	39·39	32·97	100·00	·33	1·54	·88	1·07	619·0	882·3	738·5	7·4	34·5	19·7	24·0
IV ...	59·82	19·98	20·20	100·00	·15	·12	·42	·51	1,340·0	447·6	452·5	3·3	2·6	9·3	11·3
V ...	60·52	..	...	...	·27	·87	·92	1·11	1,356·0	...	..	6·0	19·5	20·5	24·9
VI ...	19·27	28·17	22·56	100·00	·01	·83	1·07	1·30	1,104·0	631·0	505·4	·1	18·6	23·9	29·0
VII ...	71·80	9·76	19·44	100·00	·22	·51	·68	·83	1,598·0	423·4	218·6	4·93	11·42	15·23	18·49
VIII ...	69·68	18·86	11·46	100·00	·17	·52	·53	·64	1,561·0	422·4	256·6	3·81	7·17	11·87	14·43
IX ...	33·40	51·00	15·60	100·00	·36	·74	1·25	1·52	748·2	1,142·4	349·4	8·06	16·62	28·00	34·00
X ...	40·18	20·52	39 30	100·00	·14	·21	·40	·49	900·4	459·7	879·9	3·14	4·70	8·96	10·87
XI ...	46·56	25·00	28·44	100·00	·15	·52	·54	·66	1,043·0	573·5	637·6	3·36	11·65	12·10	14·69
XII ...	57·80	17·88	24·32	100·00	·18	·72	·62	·75	1,295·0	400·5	544·5	4·03	16·13	13·89	16·86
XIII ...	21·68	...	...	..	·57	2·55	...	..	485·6	...	...	12·8	57·1	...	...
XIV ...	40·60	32·14	27·26	100·00	·42	·79	1·28	1·55	909·5	720·0	620·5	9·41	17·70	28·67	34·84
XV ...	38·37	32·85	28·78	100·00	·48	1·30	1·29	1·57	859·5	735·8	644·7	10·75	29·12	28·90	35·10

ANALYSES OF PEN MANURES AND ALLIED MANURES.—(*Concluded.*)

									Pounds per Ton of 2,240 Lb.						
	Water.	Organic Matter.	Ash	Total.	Phosphoric acid (P_2O_5).	Potash (K_2O).	Nitrogen.	Ammonia (NH_3).	Water.	Organic matter.	Ash.	Phosphoric acid (P_2O_5)	Potash (K_2O).	Nitrogen.	= Ammonia (NH_3).
XVI	67·60	10·60	21·80	100·00	·069	·125	·29	·35	1,498·3	237·4	488·3	1·54	2·81	6·49	7·88
XVII	67 04	16·76	16 20	100·00	189	·133	·037	·045	1,500·8	375·4	359·7	4·23	2·98	·83	1·01
XVIII	45·6	6·30	48·10	100 00	040	506	·405	·492	1,002·8	159·8	1,077·4	·89	11·33	8·96	10·87
XIX	12·62	77·90	9·48	100·00	156	·641	2·116	2·570	282·6	1,745·0	212·4	3·49	14·43	47·40	57 60
XX	87 07	11·35	1 58	100·00	·019	26	·11	·13	1,950·4	253·1	36·5	·43	5·82	2·46	2·97
XXI	69·00	8·84	22·16	100·00	10	·58	·36	44	1,545 6	198·0	496·4	2·24	12·99	8·06	9·78
XXII	75·36	23 63	1 01	100·00	006	·148	·314	·381	1,678·9	438·5	22·6	·13	3·31	7·03	8·54
XXIII	56·98	39 13	3·89	100·00	·117	·723	·685	·832	1,276·3	876·5	87·2	2 61	16·19	15·34	18·62
XXIV .	23·83	69 95	6 22	100·00			·61	·74	533·8	1,566·9	139·3			13 7	16·6
XXV ...	17 60	74·66	7·84	100·00			·62	·75	394·2	1,670·2	175·6			13·9	16·8
XXVI	68·41	29·36	2 23	100·00			·22	·26	1,532·0	658·0	50·0			4·9	5·8
XXVII	12·51	82 33	5·21	100 00	·05	·34	·32	·38	280·0	1,844·0	116 6	1·1	7·6	7·3	5·9
XXVIII	11·17	84 57	4 26	100 00	93	98	2·86	3·47	250·2	1,894·4	95 4	20·83	21 95	64·07	77·79
XXIX	10·80	84·00	5·20	100·00	1·20	1·07	4·59	5·57	241·9	1,881·6	106·5	26·88	24·00	100·34	121·85

KEY TO TABLE SHOWING ANALYSES OF PEN MANURE AND ALLIED MANURES.

I	Pen Manure, Skerrett's.
II	„ „ , Blackman's.
III	„ „ , The Wood.
IV	„ „ , Bellevue.
V	„ „ , Lynch's.
VI	„ „ , Belmont.
VII	„ „ , Delaps.
VIII	„ „ , Gambles.
IX	„ „ , Cassada Garden.
X	„ „ , Belvidere.
XI	„ „ , Blubber Valley.
XII	Purchased stable manure, Delaps.
XIII	Sheep pen manure, Montpelier.
XIV	„ „ „ Cassada Garden.
XV	„ „ „ Barbados.
XVI	Rotted megass and compost from lees' pond, Pares.
XVII	Rotted megass, Pares.
XVIII	Vegetable compost. Scott's Hill.
XIX	Weeds, leaves, etc, Botanic Station, Dominica.
XX	Leaves of 'Dagger' (*Agave*), Cassada Garden.
XXI	Seaweed, Thibou's.
XXII	Lime skins and pulp, W. H. Moore, St. John's
XXIII	Bush, etc., Montpelier.
XXIV	Cane tops.
XXV	„ „
XXVI	„ „
XXVII	„ trash.
XXVIII	Crushed cotton seed, Cotton Factory.
XXIX	Cotton seed meal, H. E. Thorne, Barbados.

SUGAR-CANE EXPERIMENTS AT BARBADOS.

BY J. R. BOVELL, F.L.S., F.C.S.,

Agricultural Superintendent, Barbados.

Before I proceed with my paper, I should like to express my regret at the absence of my colleague, Professor d'Albuquerque, who is on leave in England on urgent private affairs.

The sugar-cane experiments at Barbados were started in 1884. The principal results of these experiments have already been from time to time laid before you at the various Conferences held by the Imperial Commissioner of Agriculture, and were brought up to date at the Conference held at Trinidad at the beginning of 1905. It is, therefore, now my duty to lay before you the results that have been obtained since then.

The experiments have been carried on in four directions: (1) to ascertain the effects of certain manurial constituents on the sugar-cane under the soil and climatic conditions existing in different parts of the island; (2) under the same conditions, to ascertain the value of certain varieties of seedling and other sugar-canes; (3) the growing of new seedlings, not only from seed ordinarily obtained, but also from seed obtained by means of cross fertilization effected by hand: and (4) to try and increase the saccharose in the sugar-cane by selecting for replanting canes rich in that constituent.

For the season 1904-6 there were 7,739 plots, including the seedlings of the first year, covering an area of about 88 acres, and for the season 1905-7, 5,727 plots, first year seedlings also included, covering an area of about 65 acres.

MANURIAL EXPERIMENTS.

The island of Barbados is practically divided into two districts, the lower land being what is known as the black-soil district, and the higher land in the centre of the island as the red-soil district.

Manurial experiments were carried on for the season 1903-5 at five estates in the black-soil district and one estate of the red-soil district. The experiments in the black soils were all with plant canes, those in the red soil were with plants and second ratoons. At Dodds, Foursquare, and Hopewell estates the plots were what are known as small experiment plots and were approximately $\frac{1}{40}$ acre, $\frac{1}{5}$ acre, and $\frac{1}{7}$ acre, respectively; those at Balls, Hampton, and Ruby estates were what are known as large experiment plots, and were approximately 1 acre each.

As full details with regard to the quantities of nitrogen, phosphates, and potash applied to the various plots, the yields per acre, etc., are given in the Reports of the Experiment Station, there is need for me but briefly to give the results of these experiments.

For 1904-6, the experiments were carried on at five estates in the black-soil district and at two estates in the red-soil district. Plant canes only were grown at Dodds, Foursquare, Balls, Hampton, and Ruby estates; plants and first ratoons at Hopewell estate; and second ratoons at Blowers estate. The sizes of the plots were approximately the same for each of the estates mentioned as for the season 1903-5, those at Blowers being 1 acre.

It may here be stated that, unless otherwise mentioned, the quantities of farmyard manure, nitrogen, phosphates, and potash referred to in this paper, are the quantities applied per acre.

These manurial experiments were instituted to ascertain: (1) the quantity of nitrogen required to produce the best results when combined with sufficient phosphate and potash to enable the nitrogen to exercise its full effect; (2) to ascertain in like manner the requirements of the sugar-cane with regard to phosphoric acid when combined with sufficient nitrogen and potash; and (3) its requirements with regard to potash when combined with nitrogen and phosphate.

For the season 1903-5, with plant canes on the small experiment plots at Dodds and Foursquare in the black soils, and at Hopewell in the red soil, to which farmyard manure had been applied, the addition of nitrogen to phosphate and potash, and potash to nitrogen and phosphate, caused increased yields, whilst the addition of phosphate to nitrogen and potash caused diminished yields.

With plant canes on the large experiment plots in the black soils, to which heavy dressings of farmyard manure had been applied, the addition of nitrogen to phosphate and potash also caused increased yields, whilst the addition of phosphate to nitrogen and potash had no appreciable effect. The canes to which the addition of potash to nitrogen and phosphate was made were accidentally burnt; consequently, the results were not recorded.

With second ratoons at Hopewell, on the small experiment plots, nitrogen and potash caused greatly increased yields, whilst the addition of phosphate to nitrogen and potash led to diminished yields.

These results were therefore confirmative of those of previous years, and need no further comment.

For the season 1904-6, with plant canes on the small experiment plots at Dodds, to which 20 tons of farmyard manure per acre had been applied, the addition of nitrogen to phosphate and potash caused increased yields, whilst the addition of potash to nitrogen and phosphate had no appreciable effect. On the other hand, the addition of phosphate this season to nitrogen and potash led, on these plots, from some cause or causes unknown, to increased yields; the increase, however, was not in proportion to the quantities of phosphate applied. The results with phosphate and potash this year are contrary to those obtained on the same field the last time these

experiments were carried out, when the addition of phosphate caused decreased, and that of potash, increased yields. The results with phosphate and potash for the season 1904-6 are also contrary to those of the past thirteen years at Dodds, where the same manures have been applied to the same plots for six years in Summervale field and seven years in Lower Bay Tree field, the latter being the field in which the results are contrary to previous years, the plot without phosphate giving, on the average for the thirteen years, more sugar per acre than any of the plots to which phosphate had been applied, with the exception of the plot to which 100 ℔. phosphate as basic slag had been applied. In this case there was a slight increase of 1·4 tons of cane per acre, but as the increase was in the basic slag plots in Summervale field, which is rather clayey, the increase is, in my opinion, due to the lime in the basic slag rather than to the phosphoric acid, as the corresponding plot in Lower Bay Tree field has given practically the same weight of canes as the no-phosphate plot.

During the seven years for which the experiments were carried out in Lower Bay Tree field on the no-phosphate plots, the canes and tops have taken out, approximately, if the amounts found by Dr. Leather, in India, on the average of four experiments, are correct, for the varieties of sugar-cane grown in Barbados, about 500 ℔. of phosphoric acid: while at the same time over 700 ℔. have been applied in the farmyard manure.

No allowance has been made for the fallen leaves, as although they are taken off the land as soon as the canes are cut, and used for mulching the canes on the experiment plots in an adjoining field, the following year the fallen leaves from the canes grown on the adjoining field are used for mulching the canes on these plots. These leaves in time decay and so return to the soil the phosphoric acid previously taken out. It is, therefore, taking everything into consideration, reasonable to assume that the decrease is not due to want of phosphoric acid in the soil, but to some other cause.

At Foursquare, the field received before the canes were planted 30 tons of farmyard manure per acre, containing 150 ℔. of nitrogen, 400 ℔. of phosphate, and 200 ℔. of potash. On the plots in this field, owing to the large quantity of farmyard manure applied, no increase followed the use of chemical manures.

At Hopewell, with plant canes on the plots which received farmyard manure at the rate of 29 tons per acre, containing 182 ℔. of nitrogen, 455 ℔. of phosphate, and 97 ℔. of potash, the addition of nitrogen to phosphate and potash, and potash to nitrogen and phosphate caused increased yields; whilst the addition of phosphate to nitrogen and potash had no appreciable effect.

With the first ratoons, owing to an attack of the fungus, *Marasmius sacchari*, the results were much obscured. One thing, however, was clear, and that was the beneficial effect of nitrogenous manures.

At Hampton, with plant and ratoon canes, the addition of nitrogen to phosphate and potash caused, with one exception, increased yields.

At Ruby, with plant canes, the addition of phosphate to nitrogen and potash caused an increased yield of 2·4 tons of cane per acre, while, with the ratoons, the yield was diminished on one plot by 1·4 tons and on the other by 0·4 tons.

At Balls, with plant canes, the addition of potash to nitrogen and phosphate caused a slight increase of 2 tons of cane per acre.

At Blowers, with ratoon canes, the addition of potash to nitrogen and phosphate caused a slight increase, which was, however, less than ½ ton of cane per acre.

From the results of the two seasons it may be stated briefly :—

(1) That under the soil and climatic conditions existing at the experiment stations in Barbados, the addition of nitrogen to plant and to ratoon canes is profitable; the quantity depending to a great extent on the rainfall, and to a lesser extent on the amount of farmyard manure applied to the land.

(2) That although in a few instances the addition of phosphate to nitrogen and potash has led to increased yields with plant canes, the results, on the whole, for the two seasons, supplemented by those of previous years, point to the conclusion that the addition of this constituent is unnecessary to either plant or ratoon canes.

(3) That the addition of potash to plant and ratoon canes leads to increased yields.

The question has recently been raised in Barbados as to whether phosphatic manures have any effect on the richness and purity of the juice; therefore, before I leave the subject of manures, it may not be without interest if I say something with regard to the quality of the juice of the canes grown on the phosphate plots.

As I have said above, phosphates have been applied to two fields at Dodds for thirteen years. During that time, the saccharine richness of the juice from the plots to which 40 lb. of phosphate have been applied was slightly lower than the no-phosphate plot during six seasons, slightly higher during six, and in one season it remained the same. In all the other plots it was lower than the no-phosphate plot.

The following is a table showing the average quality of the juice from these plots for the thirteen years:—

Quantity of phosphate applied.	Saccharose. Pounds per gallon.	Glucose. Pounds per gallon.	Glucose Ratio.	Quotient of Purity.	Total Solids.
No phosphate ...	2·027	·056	2·76	89·29	2·270
40 lb. as superphosphate	2·044	·056	2·74	89·61	2·281
80 lb. as superphosphate	2·024	·053	2·62	88·42	2·289
120 lb. as superphosphate	2·025	·059	2·91	89·44	2·264
40 lb. + 40 lb. as superphosphate . .	2·018	·062	3·07	88·98	2·268
60 lb. + 60 lb. as superphosphate .	2·024	·062	3·06	89·32	2·266
80 lb. as basic slag ..	2·024	·057	2·82	89·06	2·272
100 lb. as basic slag...	2·004	·059	2·94	88·91	2 254

From the results given in the table it will be seen that manuring with phosphoric acid does not increase the richness or purity of the juice.

SEEDLING AND OTHER VARIETIES.

At the close of 1904, 6,769 new seedlings were obtained. These included seventy-eight which had been grown from inflorescences which had been bagged to prevent cross-fertilization. These seedlings were tested in 1905 and ninety-six, from their field characters and the analytical results of the juice, were considered worthy of further trial. In order to increase them as rapidly as possible, the stools were divided into halves, replanted and grown under irrigation. During the following December, the canes in these stools were made into cuttings and replanted.

The 4,874 seedlings obtained at the close of 1905 are now being grown and will be tested in May this year, when all those canes giving above a certain weight per clump and a certain amount of saccharose per gallon, depending upon the climatic conditions which have existed for the season, will be replanted.

With regard to the varieties at present under cultivation at Barbados, Tables I, II, III, and IV give the average results of some of the better of the plant canes for three years, and of ratoon canes for the past two years.

The following is a table showing the parent canes, the number of seedlings obtained therefrom, and the percentage of seedlings which passed the first test:—

Name of Parent cane.	No. obtained.	No. selected.	Percentage of selection.
B. No. 1,030	1,491	11	0·74
1,233	631	22	3·49
1,283	208	0	0·00
1,462	504	10	1·98
1,719	288	6	2·08
1,753	12	0	0 00
3,207 . ..	259	2	0·77
3,208	309	3	0·97
3,209	143	3	2·10
3,211 .. .	209	5	2·39
3,625 . ..	11	0	0·00
3,718 . .	33	1	3 00
3,874	101	1	1·00
3,921	218	0	0·00
4,290	104	2	1·92
4,340	259	0	0 00
4,347	198	2	1·00
4,388	178	0	0·00
4,397	22	0	0·00
4,993	173	7	1·48
4,995	48	2	4·16
5,035	22	1	4·54
5,102	48	2	4·16
5,103	40	1	2 50
5,108	273	6	2·19
5,183	198	3	1·52
6,048	10	0	0·00
6,104	51	0	0·00
Collymns Seedling ...	228	3	1·31
Naga B.	68	0	0·00
Queensland Creole ...	8	0	0·00
Rappoe...	46	0	0·00
B. 1,376 S. 1	30	1	3·33
1,529 S. 6	48	2	4·16
	6,709	96	Average. 1·49

TABLE I.

VARIETIES ARRANGED ACCORDING TO YIELD OF SACCHAROSE.

BLACK SOILS.—PLANTS

AVERAGE OF THE MEAN RESULTS FOR THE YEARS 1904, 1905, 1906.

Name or No. of Cane.	No of Plots.	No. of years under Experiment	Tons per acre.	Saccharose. Pounds per gallon.	Glucose. Pounds per gallon	Quotient of Purity.	Glucose Ratio.	Saccharose Pounds per acre	Prevalence of *Marasmius sacchari*.
1. B. 3,696	6	3	36·99	2·022	·060	88·05	3·40	9,499	Badly attacked 1905; slightly 1906.
2. B 1,753	3	3	42 06	1·951	078	87·40	3·84	9,390	None.
3. B. 3,289	4	3	36·18	2·037	047	89 62	2 33	9,319	None
4 B. 1,030	4	3	37·47	2 023	·045	88 21	2·24	8,973	None 1904, 1905: badly attacked 1906.
5. B. 1,355	3	3	33 80	2·084	·048	91 12	2·32	8,850	None 1904, 1905; badly attacked 1906.
6. B. 6,048	4	3	34 74	1·932	·088	85·88	4 75	8,724	None.
7. B. 3.708	3	3	37 04	1·918	068	88·15	3 58	8,684	Slightly attacked.
8. B 1,376	3	3	32 85	2 055	057	90·21	2·79	8,374	None 1904, 1905; badly attacked 1906.
9. B. 3,859	3	3	37 31	1 876	097	84·26	5·90	8,335	Very slightly attacked.

TABLE I.—(*Continued.*)

VARIETIES ARRANGED ACCORDING TO YIELD OF SACCHAROSE.

BLACK SOILS.—PLANTS.

AVERAGE OF THE MEAN RESULTS FOR THE YEARS 1904, 1905, 1906.

Name or No. of Cane.	No. of Plots.	No. of years under Experiment.	Tons per acre.	Saccharose. Pounds per gallon.	Glucose. Pounds per gallon.	Quotient of Purity.	Glucose Ratio.	Saccharose. Pounds per acre.	Prevalence of *Marasmius sacchari*.
10. B. 1,529.. ...	16	3	28·43	2·424	·037	92·20	1·52	8,308	None, or very slightly attacked.
11. B. 1,809... ...	3	3	33·26	2·050	·089	89·30	4·32	8,308	None.
12. B. 3,853... ...	3	3	34·55	1·909	·072	88·83	3·86	8,283	Slightly 1904, 1906; badly 1905.
13. B. 4,028... ...	3	3	39·90	1·637	·088	80·71	5·54	8,277	None, or very slightly attacked.
14. B. 4,769... ..	3	3	33·12	1·949	·094	85·83	4·98	8,205	None.
15. B. 3,838... ...	3	3	36·51	1·824	·117	84·21	6·42	8,197	None 1905, slightly 1906.
16. B. 1,528... ...	3	3	32·73	2·024	·057	89·88	2·80	8,192	None ; slightly attacked 1906.
17. B. 3,819... ...	3	3	35·94	1·928	·079	87·68	4·27	8,176	Very slightly attacked.
18. B. 3,635... ...	6	3	31·41	2·122	·048	89·79	2·28	8.144	Slightly attacked 1905 ; badly 1906.

TABLE I.—(*Continued.*)

VARIETIES ARRANGED ACCORDING TO YIELD OF SACCHAROSE.

BLACK SOILS.—PLANTS.

AVERAGE OF THE MEAN RESULTS FOR THE YEARS 1904, 1905, 1906.

Name or No. of Cane.	No. of Plots.	No. of years under Experiment.	Tons per acre.	Saccharose. Pounds per gallon.	Glucose. Pounds per gallon.	Quotient of Purity.	Glucose Ratio.	Saccharose. Pounds per acre.	Prevalence of *Marasmius sacchari.*
19. B. 3.209 .. .	3	3	30·69	2·061	·064	89·44	3·12	7.885	None, or slightly attacked.
20. B. 3,700	3	3	32·41	1·977	·061	88·78	3·07	7,839	Very slightly attacked.
21. B. 5,353	3	3	30·89	1·998	·074	87·23	3·74	7,827	Very slightly attacked.
22. B. 5,062... ..	4	3	33·51	1·939	·063	86·03	3·27	7,790	Slightly attacked.
23. B. 4,596... ...	3	3	34·24	1·785	·095	85·28	5·35	7.661	None 1904, 1905: slightly 1906.
24. B. 4.161	3	3	40·84	1·515	·150	77·61	10·00	7,596	None.
25. B. 3,381	6	3	29·42	2·257	·050	90·60	2·26	7,576	None 1904, 1905 ; badly 1906.
26. B. 4,844 . ..	3	3	33·34	1·826	·104	84·10	6·16	7,555	None.
27. B. 3,207... ...	3	3	29·66	2·021	·058	88·99	2 88	7.503	None 1904, 1905; slightly 1906.

TABLE I.—(*Continued.*)

VARIETIES ARRANGED ACCORDING TO YIELD OF SACCHAROSE.

BLACK SOILS.—PLANTS.

AVERAGE OF THE MEAN RESULTS FOR THE YEARS 1904, 1905, 1906.

Name or No. of Cane.	No. of Plots.	No. of years under Experiment	Tons per acre.	Saccharose. Pounds per gallon.	Glucose. Pounds per gallon.	Quotient of Purity.	Glucose Ratio.	Saccharose. Pounds per acre.	Prevalence of *Marasmius sacchari.*
28. B. 3,656... ...	4	3	31·31	1·930	·068	86·96	3·56	7,503	Slightly attacked 1905, none 1906.
29. B. 3,876	3	3	34·58	1·754	·118	83·72	6·81	7,493	None.
30. B. 3,211... ...	4	3	27·49	2·149	·045	91·04	2·10	7,489	None, or slightly attacked.
31. B. 5,135... ..	3	3	30·40	1·955	·087	86·60	4·43	7,464	None.
32. B. 3,731 ..	3	3	27·45	2·167	·052	90·75	2·52	7,458	Badly attacked.
33. B. 147 ..	13	3	30·02	1 905	·076	86·86	3·99	7,368	Slightly or none 1904, '05; badly 1906.
34. B. 3,750 ..	3	3	30·02	1·936	·066	87·98	3·41	7,281	Slightly attacked.
35. B. 3,013 ..	3	3	29·32	1·884	·082	88·03	4·43	7,176	None.
36. B. 5,014... ...	3	3	27·83	2·172	·062	89·96	2·85	7,176	None 1904, 1905 : slightly 1906.

TABLE I.—(*Continued.*)

VARIETIES ARRANGED ACCORDING TO YIELD OF SACCHAROSE.

BLACK SOILS.—PLANTS.

AVERAGE OF THE MEAN RESULTS FOR THE YEARS 1904, 1905, 1906.

Name or No. of Cane.	No. of Plots.	No. of years under Experiment.	Tons per acre.	Saccharose. Pounds per gallon.	Glucose. Pounds per gallon.	Quotient of Purity.	Glucose Ratio.	Saccharose. Pounds per acre.	Prevalence of *Marasmius sacchari*.
37. B. 4,929... ...	3	3	30·87	1·945	·101	86·38	5·28	7,169	Very slightly attacked.
38. B. 4,031... ...	3	3	21·19	1·759	·107	82·46	6·06	7,107	None: slightly attacked 1905.
39. B. 3,729	5	3	28·51	1·986	·060	89·48	3·07	7,095	Badly attacked.
40. B. 3,509... ..	3	3	29·21	2·178	·051	90·54	2·33	7,090	Slightly attacked: badly 1906.
41. B. 3,224	3	3	27·56	2·047	·065	90·91	3·18	7,036	None, or slightly attacked.
42. B. 5,078... ...	3	3	36·43	1·559	·148	81·59	9·49	7,005	None 1904, 1905; slightly 1906.
43. B. 5,110	3	3	27·44	2·059	·069	88·54	3·38	6,988	None 1904, 1905; slightly 1906.
44. B. 208	40	3	24·93	2·281	·044	91·10	1·96	6,981	None, or very slightly attacked.
45. B. 5,226.	3	3	27·18	2·177	·053	88·73	2·43	6,981	None; slightly 1906.

TABLE I.—(*Continued.*)

VARIETIES ARRANGED ACCORDING TO YIELD OF SACCHAROSE.

BLACK SOILS.—PLANTS.

AVERAGE OF THE MEAN RESULTS FOR THE YEARS 1904, 1905, 1906.

Name or No. of Cane.	No. of Plots.	No. of years under Experiment.	Tons per acre.	Saccharose. Pounds per gallon.	Glucose. Pounds per gallon.	Quotient of Purity.	Glucose Ratio.	Saccharose. Pounds per acre.	Prevalence of *Marasmius sacchari.*
46. B. 3,735... ...	3	3	27·91	2·074	·074	88·17	3·63	6.971	Slightly attacked.
47. B. 5,758... ...	4	3	27·66	2·065	·065	90·05	3·22	6,945	Very slightly attacked.
48. B. 4,507... ...	3	3	29·71	2·096	·051	89·34	2·41	6,913	None.
49. B. 5,204... ...	3	3	26·65	2·065	·062	88·17	3·03	6,881	None; slightly attacked 1906.
50. B. 5,102... ...	4	3	29·35	1·965	·067	87·58	3·39	6,868	None 1904; moderate 1905; badly 1906.
51. B. 5,068... ...	3	3	32·30	1·640	·127	78·48	8·08	6,858	None: slightly 1906.
52. B. 3,694... ...	3	3	32·11	1·700	·125	82·00	7·56	6,846	None, or very slightly attacked.
53. B. 5,066... ...	4	3	29·42	1·935	·066	85·62	3·43	6,829	None 1904; slightly 1905, 1906.

TABLE I.—(*Continued*)

VARIETIES ARRANGED ACCORDING TO YIELD OF SACCHAROSE.

BLACK SOILS.—PLANTS.

AVERAGE OF THE MEAN RESULTS FOR THE YEARS 1904, 1905, 1906.

Name or No. of Cane.	No. of Plots.	No. of years under Experiment.	Tons per acre.	Saccharose. Pounds per gallon.	Glucose. Pounds per gallon.	Quotient of Purity.	Glucose Ratio.	Saccharose. Pounds per acre.	Prevalence of *Marasmius sacchari*.
54. B. 3,681... ...	3	3	28·30	1·872	·080	83·26	4·35	6,798	Slight 1904, 1905 : none 1906.
55. B. 2,942... ...	3	3	27·44	2·012	·056	90·45	2·78	6,762	None.
56. B. 4,927... ...	3	3	27·71	2·008	·069	86·53	3·57	6,752	None.
57. B. 1,233... .	3	3	27·56	1·942	·060	87·97	3·12	6,751	None 1904, 1905 ; badly 1906.
58. B. 1,283... .	3	3	29·81	1·875	·106	87·28	5·84	6,741	Slightly attacked.
59. B. 5,076... ..	3	3	29·94	2·071	·059	88·11	2·88	6,714	None, or slightly attacked.
60. B. 376	26	3	26·51	2·080	·055	90·06	2·73	6,706	None or slight 1904, '05: moderate 1906.
61. B. 5,298 .. .	3	3	25·27	2·216	·052	89·89	2·50	6,700	None.

TABLE I.—(*Concluded*)

VARIETIES ARRANGED ACCORDING TO YIELD OF SACCHAROSE.

BLACK SOILS.—PLANTS.

AVERAGE OF THE MEAN RESULTS FOR THE YEARS 1904, 1905, 1906.

Name or No. of Cane.	No. of Plots.	No. of years under Experiment.	Tons per acre.	Saccharose Pounds per gallon.	Glucose. Pounds per gallon.	Quotient of Purity.	Glucose Ratio.	Saccharose. Pounds per acre.	Prevalence of *Marasmius sacchari*.
62. B. 4,086	3	3	29·60	2·212	·034	91·80	1·55	6,686	Badly attacked
63. B. 3,701...	3	3	32·30	1 753	·108	82·42	6 25	6,682	None 1904, 1905 : badly 1906.
64. B. 1,475	3	3	25 50	2·089	·055	90·35	2 61	6,653	Badly attacked
65. B 3.810	3	3	28·53	1·657	103	82·96	6 57	6,642	None
66. B. 4,578	3	3	28·06	1 886	089	84 25	4·72	6,622	None : slightly attacked 1906.
67. B. 1,607	6	3	26 78	2·028	·060	87·07	3·07	6,615	None, or slightly attacked.
68 White Transparent	62	3	26 44	2 055	060	89.60	2 94	6,603	None, or very slight.
103 Bourbon	3	3	25·65	1·868	·109	86 26	5·90	6,147	Slight 1904-1905: moderate 1906.

TABLE II.

VARIETIES ARRANGED ACCORDING TO YIELD OF SACCHAROSE.

BLACK SOILS.—RATOONS.

AVERAGE OF THE MEAN RESULTS FOR THE YEARS 1904, 1905, 1906.

Name or No. of Cane.	No. of Plots.	No. of years under Experiment.	Tons per acre.	Saccharose. Pounds per gallon.	Glucose. Pounds per gallon.	Quotient of Purity.	Glucose Ratio.	Saccharose. Pounds per acre.	Prevalence of *Marasmius sacchari*.
1. B. 1,753 … ..	2	2	34 91	2·072	·050	89·67	2 38	7,798	None.
2. B. 1,283	2	2	25·34	2·176	·038	91·86	1·72	6,355	Slightly attacked.
3. B. 3,207	2	2	23·52	2·178	·047	90·67	2·17	6,008	Slightly attacked.
4. B. 1,355	2	2	23·14	2·190	·038	91·95	1·76	5,879	Badly attacked.
5. B. 3,209 … .	2	2	22·51	2 167	·054	91·91	2·49	5,601	Badly attacked.
6. B. 1,528 … ..	2	2	21·98	2·242	·039	92·25	1·73	5,581	Slightly attacked.
7. B. 1,529 … …	5	2	18 26	2·516	·098	92·72	3·89	5,106	None, or slightly attacked.
8. D. 95 … .	7	3	17·44	2·199	·042	92·29	1·97	4,610	None, or slightly 1905 : badly 1906.
9. B. 1,376 … .	2	2	16·98	2·214	·049	92·06	2·24	4,428	Badly attacked.

TABLE II.—(*Continued.*)

VARIETIES ARRANGED ACCORDING TO YIELD OF SACCHAROSE.

BLACK SOILS.—RATOONS.

AVERAGE OF THE MEAN RESULTS FOR THE YEARS 1904, 1905, 1906.

Name or No. of Cane.	No. of Plots.	No of years under Experiment	Tons per acre	Saccharose Pounds per gallon.	Glucose Pounds per gallon	Quotient of Purity	Glucose Ratio.	Saccharose. Pounds per acre.	Prevalence of *Marasmius sacchari*
10. La Tib Merde	2	2	16·47	2 278	·035	92 06	1 54	4,362	Badly attacked
11. B. 208	9	3	15 01	2 304	037	92 86	1 63	4,203	Slightly attacked 1905 ; badly 1906.
12. B. 1,462	2	2	17 50	2 158	049	90 95	2 27	4,178	Badly attacked
13. W No. 2	4	2	16 79	2 129	048	92 54	2 26	4,158	None, or slightly attacked
14. W. Transparent	15	3	15·77	2 142	045	91 82	2 11	3,973	None, or slightly attacked
15. B. 147	2	1	16 03	1 877	066	86 02	3 52	3,920	None
16. B. 376	10	3	15 49	2·145	041	92 60	1 91	3,882	None 1904 , slightly 1905 : none 1906.
17. B. 3,224	1	1	13 59	2 229	·042	91 77	1 88	3,827	Slightly attacked
18. B. 3,289	1	1	14 26	2·112	056	90 48	2 65	3,605	Slightly attacked

TABLE II.—(*Continued.*)

VARIETIES ARRANGED ACCORDING TO YIELD OF SACCHAROSE.

Black Soils.—Ratoons.

AVERAGE OF THE MEAN RESULTS FOR THE YEARS 1904, 1905, 1906.

Name or No. of Cane.	No. of Plots	No of years under Experiment.	Tons per acre.	Saccharose Pounds per gallon.	Glucose. Pounds per gallon.	Quotient of Purity.	Glucose Ratio.	Saccharose. Pounds per acre.	Prevalence of *Marasmius sacchari.*
9. B 1,233	2	2	14·30	2·107	·055	89·44	2·62	3,572	Slightly attacked.
20. B. 3,233 .	3	2	14·90	1·991	·060	90·28	3·04	3,562	None, or slightly attacked.
21. B. 2,550	2	2	13 75	2 025	·062	90·12	3·05	3,496	None 1905 ; badly 1906.
22. B. 3,381	2	1	12·74	2·207	·042	86·96	1·92	3,407	Slightly attacked.
23. HusbandsSportRed	3	2	13·13	2·266	·055	91 67	2·42	3,374	Slightly 1905 : badly 1906.
24. B. 1,719 ..	3	1	11·39	2·195	·044	90·52	2·02	3,135	Badly attacked.
25. B. 2,652 .	2	2	15 83	1·517	·102	78·30	10·29	3,073	Slightly 1905 ; badly 1906
26. B. 2,821 ...	2	2	12 00	2·108	·043	89·97	2·04	2,985	None, or slightly attacked
27. B. 1,030	2	2	12·81	2·159	·042	90 33	1·94	2,938	Badly attacked.

TABLE II.—(*Concluded.*)

VARIETIES ARRANGED ACCORDING TO YIELD OF SACCHAROSE.

BLACK SOILS.—RATOONS.

AVERAGE OF THE MEAN RESULTS FOR THE YEARS 1904, 1905, 1906.

Name or No. of Cane.	No. of Plots.	No. of years under Experiment.	Tons per acre.	Saccharose. Pounds per gallon.	Glucose. Pounds per gallon.	Quotient of Purity.	Glucose Ratio.	Saccharose. Pounds per acre.	Prevalence of *Marasmius sacchari.*
28. White Sport	6	3	12·11	1·922	·078	85·48	4·08	2,904	None, or slightly attacked.
29. Crystalline ...	3	2	10·71	2·090	·100	87 30	5·12	2,560	Badly attacked.
30. B. 2,819.. ..	2	2	10·88	2·027	·060	90·05	2·96	2,554	None, or slightly attacked.
31. B. 1,607... ...	2	2	15·14	2·059	·062	89·67	2·98	2,473	Very badly attacked.
32. B. 2,938... ..	1	1	11·16	2·022	·063	90·75	3·11	2,430	None.
33. B. 3,425.. ..	1	1	9·00	2·138	·056	92·04	2·62	2,343	Slightly attacked.
34. B. 3,213... ...	1	1	7·74	2·106	·058	91·12	2·75	1,984	Badly attacked.
35. B. 3,509... ...	1	1	7·35	2·240	·040				Badly attacked.

TABLE III.

VARIETIES ARRANGED ACCORDING TO YIELD OF SACCHAROSE.

RED SOILS.—PLANTS.

AVERAGE OF THE MEAN RESULTS FOR THE YEARS 1904, 1905, 1906.

Name or No. of Cane.	No. of Plots.	No. of years under Experiment.	Tons per acre.	Saccharose. Pounds per gallon.	Glucose. Pounds per gallon.	Quotient of Purity.	Glucose Ratio.	Saccharose. Pounds per acre.	Prevalence of *Marasmius sacchari*.
1. B. 3,412	3	3	42·09	1·982	·067	87·28	3·53	10,849	None.
2. B. 3,390	3	3	40·85	1·891	·068	87·57	3·62	9,613	None.
3. B. 1,566	5	3	38·17	1·933	·058	88·66	3·05	9,451	Badly 1904; none 1905; slightly 1906.
4. B. 3,405	3	3	39·18	1·873	·070	85·45	3 80	9,430	None.
5. B. 208	10	3	29·47	2·149	·042	90·43	2·18	8,133	None, or very slightly attacked.
6. B. 1,529	5	3	27·87	2·360	·032	93·68	1·38	7,828	None, or very slightly attacked.
7. B. 376	10	3	31·29	1 869	·075	88·51	4·20	7,529	None, or very slightly attacked.
8. D. 95	6	3	27·10	2·017	·057	90·83	2·94	7,307	None, or very slightly attacked.
9. B. 1,521	5	3	25·80	2·062	·050	86 30	2 79	6,619	Slightly 1904: none 1905; badly 1906.
10. W. Transparent	13	3	26·51	1·875	·069	87·88	3·74	6,151	None, or slightly attacked.

TABLE IV.

VARIETIES ARRANGED ACCORDING TO YIELD OF SACCHAROSE

RED SOILS.—RATOONS.

AVERAGE OF THE MEAN RESULTS FOR THE YEARS 1904, 1905, 1906.

Name or No. of Cane.	No of Plots.	No of years under Experiment.	Tons per acre	Saccharose Pounds per gallon	Glucose. Pounds per gallon	Quotient of Purity	Glucose Ratio	Saccharose. Pounds per acre	Prevalence of *Marasmius sacchari*.
1. B 3,390	2	2	34·84	1 794	078	85 33	4 33	7.076	None
2 D 95	6	3	25 55	2 014	042	91 07	2 13	6 488	Slightly attacked
3. B 376	6	3	26 04	1 899	050	90·42	2 74	6 178	Slightly attacked
4. W. Transparent	6	3	24 69	1 929	056	89 66	2 93	6,135	None, or slightly attacked.
5 B. 3,405	2	2	27 53	1 690	088	80 94	5 35	5.465	None
6. B. 208	6	3	19 56	2 145	035	91 91	1 63	5.381	None, or slightly attacked.
7. B 3,412	2	2	25 78	1 743	075	81 39	4 37	5.316	None, or slightly attacked.
8. B. 1,566	3	2	22 36	1 872	053	89 50	2 85	5 192	Badly attacked
9 B. 1,529	3	2	14 50	2 454	·027	93 24	1 08	4,250	Slightly attacked
10. B. 1.521	3	2	13 19	2·086	·037	89 93	1 75	3,400	Badly attacked.

As will be seen by referring to these tables, the highest yield in the black soils, on the average for the three years, was given by B. 3,696, which gave 9,499 ℔. of saccharose per acre, followed by B. 1,753 with 9,390 ℔., B. 3,289 with 9,319 ℔., and B. 1,030 with 8,973 ℔. per acre, as compared with the White Transparent, which gave 6,603 ℔. per acre. The highest yield with plant canes in the red soils was given by B. 3,412 with 10,849 ℔. saccharose per acre, followed by B. 3,390 with 9,613 ℔., B. 1,566 with 9,451 ℔., and B. 3,405 with 9,430 ℔. saccharose per acre, as compared with the White Transparent, which gave 6,151 ℔. per acre. With ratoons in the black soils, the highest yield was given by B. 1,753 with 7,798 ℔. saccharose per acre, followed by B. 1,283 with 6,355 ℔., B. 3,207 with 6,008 ℔., and B. 1,355 with 5,879 ℔. saccharose per acre, as compared with the White Transparent which gave 3,973 ℔. saccharose per acre. In the red soils with ratoons, B. 3,390 gave the highest result, yielding 7,076 ℔. saccharose per acre, followed by D. 95 with 6,488 ℔.; and B. 376 with 6,178 ℔., as compared with the White Transparent which gave 6,135 ℔. saccharose per acre.

It must, however, in fairness be stated, that the higher numbered varieties have only been under cultivation on a small number of plots each year, whereas of the older seedlings and the White Transparent there were a large number of plots, viz., sixty-two of the White Transparent, forty of B. 208, and thirteen of B. 147.

Since 1900, experiments have been carried out with the object of ascertaining whether it is possible by repeatedly selecting plants from canes with the highest saccharose content and purity of juice, gradually to increase the saccharine richness of the sugar-cane. A full description of how these experiments were carried out was given at the last Conference.

For the season 1904-5, owing to an accident, the results cannot be stated. For the season 1905-6, the average content of the seed canes highest in saccharose planted was 2·12 ℔. saccharose per gallon, and of the canes obtained from these 1·79 ℔. per gallon. In the case of the seed canes lowest in saccharose, those that were planted had an average content of 1·53 ℔. of saccharose per gallon, and the canes from them gave 1·68 ℔. per gallon.

With regard to these results, it may be stated that, taking into account the necessary errors of experiment, they have up to the present failed to show any well defined differences between the juice from the high and that from the low plots.

HYBRIDIZATION AND OTHER EXPERIMENTS WITH VARIETIES.

In 1904, Mr. L. Lewton-Brain, B.A., assisted by Mr. C. T. Murphy, cross-fertilized twelve flowers on twenty-five different inflorescences. From these were obtained five seedlings. At the same time as these canes were being cross-fertilized, three inflorescences each of the canes B. 1,355, B. 1,376, B. 1,529, and B. 3,289 were bagged before the extrusion of the stigmata, so that the flowers should not be cross-fertilized. From these latter, six seedlings were obtained. Numbers have been given to the

seedlings so obtained, and in December 1905, 270 cuttings were planted from these canes, and they will be tested this year. Cuttings were made last December from a portion of these canes, and there are at present 769 stools growing, the canes from which will be tested in 1908.

At the end of 1905, Mr. F. A. Stockdale, B.A., assisted by Mr. C. T. Murphy, cross-fertilized a number of flowers of different inflorescences, but unfortunately, owing to unfavourable weather conditions, no seedlings were obtained. At the same time a number of inflorescences were bagged before the extrusion of the stigmata, and from these nine canes were obtained from the seedling B. 6,048. These will be tested this year, and any worthy of further cultivation, replanted.

Last December, these gentlemen pollinated 1,050 flowers of different varieties, but as yet, it is too soon to say what the results are likely to be. At the same time one inflorescence of the White Transparent and two of B. 3,289 were bagged before the extrusion of the stigmata. In the case of the White Transparent an inflorescence of B. 6,018 was inserted for the purpose of cross-fertilization. In the case of one of the B. 3,289, the inflorescence inserted was B. 3,696, and in the other B. 6,048.

In 1902, a number of the seedling canes, B. 208 and D. 95, were planted in alternate rows, and in alternate holes in the rows, i.e., chess-board fashion, in such a position that they would not be likely to be cross-fertilized by canes of other varieties. From these canes were obtained 196 seedlings. From their field characters and saccharose content, fourteen canes have been thought worthy of further trial. Of these fourteen, five resemble the D. 95, four the B. 208, four partake of the characters of both canes, and one resembles neither.

The following is a description of the canes that have been replanted :—

B. 8,520.—Medium-sized, pale-red cane: upright in habit; twelve to twenty in the clump; internodes slightly tumid, 3 to 6 inches long; dry leaves fall readily; no flowers; eyes large and prominent. Resembles D. 95, except in colour.

B. 8,528.—Medium-sized, dark-red cane; upright in habit; fourteen to twenty canes to the clump; internodes cylindrical in shape, 3 to 7 inches long; few flowers; dry leaves fall readily; eyes small but full. Resembles D. 95.

B. 8,533.—Small-sized, red cane; upright in habit; ten to sixteen canes to the clump; internodes cylindrical in shape, 2 to 6 inches long, with a longitudinal channel above the eye; no flowers; dry leaves fall readily; eyes very small and flat. Resembles D. 95.

B. 8,522.- Short, pale-yellow cane; upright in habit; ten to sixteen canes to the clump; internodes tumid, 2 to 3 inches long; dry leaves fall readily; no flowers; eyes large and prominent. Resembles B. 208.

B. 8,555.—Medium-sized, yellow cane; slightly recumbent in habit; thirteen to eighteen to a clump; internodes cylindrical in shape, with longitudinal channel above the eye, 3 to 7 inches long; flowers freely; dry leaves fall readily; eyes small and flat. Slightly resembles B. 208.

B. 8,564.—Small, dark-red cane: recumbent in habit; ten to seventeen canes to a clump; internodes cylindrical in shape, 2 to 6 inches long; dry leaves slightly adherent; flowers freely; eyes small and full. Somewhat resembles D. 95.

B 8,574.—Medium-sized, red cane; slightly recumbent in habit; twelve to seventeen canes in a clump; internodes cylindrical in shape, 2 to 6 inches long; dry leaves slightly adherent; few flowers; eyes small and round. This cane has characters of both B. 208 and D. 95

B. 8,579.—Small, pale-red cane; recumbent in habit; twelve to eighteen canes in a clump; internodes cylindrical in shape, 4 to 7 inches long; flowers freely; dry leaves somewhat adherent; eyes small and prominent. Resembles D. 95.

B. 8,600.—Medium-sized, purplish-yellow cane; upright in habit; fifteen to eighteen canes to a clump; internodes cylindrical in shape, with longitudinal channel above the eye; dry leaves somewhat adherent; few flowers; eyes large and full. This cane has characters of both B. 208 and D. 95.

B. 8,606.—Large-sized, dark-red cane; upright in habit; eight to twelve canes to a clump; internodes cylindrical in shape, 2 to 6 inches long; dry leaves fall readily; no flowers; eyes round and prominent. This cane has characters of both B. 208 and D. 95.

B. 8,607.—Large-sized, green cane; upright in habit; seven to twelve canes to a clump; internodes cylindrical in shape, 2 to 5 inches long; dry leaves adherent; no flowers; eyes small and full. Resembles neither B. 208 nor D. 95.

B. 8,609.—Large, pale-yellow cane; upright in habit; seven to eleven canes to a clump; internodes tumid in shape, 2 to 5 inches long; dry leaves fall readily; few flowers; eyes small and prominent. Resembles B. 208, except in colour.

B. 8,651.—Large-sized, red cane; upright in habit; eight to eleven canes to a clump; internodes slightly tumid, 2 to 5 inches long; dry leaves fall readily; no flowers; eyes small and full. This has characters of both B. 208 and D. 95.

B. 8,660.—A large, yellow cane; upright in habit; seven to ten canes to a clump; internodes tumid, 2 to 4 inches long; dry leaves fall readily; no flowers; eyes small and full. Resembles B, 208,

The following is a table giving the weight of cane and the saccharose content of these fourteen canes :—

No. of cane.	Cane it resembles.	Weight per hole. Pounds.	Saccharose. Pounds per gallon.
8,520	D. 95	43	1·934
8,528	"	38	2·312
8,533	"	54	2·067
8,564	"	36	2 294
8,570	"	45	2·113
8,522	B. 208	35	2·229
8,555	"	44	1 980
8,609	"	33	2 069
8,660	"	36	2·009
8,574	Having characters of B. 208 and D. 95	33	2·104
8,600	"	51	2·117
8,606	"	45	1·988
8,651	"	41	2·138
8,607	Not like either B. 208 or D. 95.	25	2 365

IMPORTANCE OF THE SUGAR-CANE EXPERIMENTS TO THE SUGAR INDUSTRY.

It may not be without interest if I say something now with regard to those seedlings which have been cultivated for some time, so as to give an idea of the importance to the sugar industry of the sugar-cane experiments now being carried on in the West Indies.

At Barbados during the season 1904-6, through the courtesy of several planters, we have been able to obtain the results of some of the better seedling canes, where they were grown in the same field, and under the same conditions, as the White Transparent—the standard cane. The following is a table giving these returns :—

Name of Estate.	Name of Cane.	Area of Plot. Acres.	Saccharose. Pounds per acre.	Increase as compared with White Transparent.
Husbands.	White Transparent	·402	7,212	..
	B. 147	·402	8,321	1,109 lb.
	B. 208*	·402	9,819	2,607 „
Mangrove Pond.	White Transparent	3·000	7,720	...
	B. 208	3·000	9,770	2,050 „
Henley.	White Transparent	1·860	8,421	...
	B. 208	1·860	10,919	2,498 „

*Average of two plots, each ·402 acre in size.

To give some idea of the length of time it takes for a seedling to reach the stage at which it can be tried on a large scale on sugar estates, I may mention that B. 376, which has just been cultivated in Barbados at Brighton on a comparatively large area, was first obtained in 1895; so that over ten years have elapsed before this cane was tried on a fairly large scale. For several years past, the Hon. G. L. Pile, M.L.C., the proprietor of the estate, has been growing this cane on gradually increasing areas until last year he reaped 58 acres of this variety out of a total area of 90 acres of plant canes. The remaining 32 acres were planted with other varieties. At a meeting of the Agricultural Society at Barbados last month, Mr. Pile stated that the 58 acres gave an average yield of 29½ tons of cane per acre, some a little less, some a little more, the largest yield from one field being 36 tons per acre. With regard to the juice, he said, it was particularly good, and that he had obtained, on the average, 2·95 tons of sugar per acre. In reply to a question put to him by a member present, Mr. Pile stated that the 32 acres of other canes had given him about ¾ ton of sugar less per acre than the B. 376, and that this cane gave a much better yield than any other cane which he had reaped as first ratoons, giving, on the average, about 2 tons of sugar per acre. It was, he continued, a cane which germinated well, withstood dry weather well, and gave not only good plant canes but also good ratoons.

With regard to B. 147 at Barbados, last year, Mr. A. Cameron, the attorney for several estates in that island, was good enough to supply us with returns obtained from four estates. On one estate the returns were for three years as plant canes and two years as ratoons, and on the other three, the returns were for two years as plants and two years as

ratoons. On the first estate for the three years, there was an average of 114 acres of B. 147 as plant canes and 45 acres of the White Transparent, the cane usually planted at Barbados. During that period B. 147 gave, on the average, 320 lb. more sugar per acre per annum than the White Transparent. With regard to the other three estates, there was an average of 92 acres of B. 147 as plants and 55 acres of the White Transparent. The B. 147 in this instance gave an average of 226 lb. of sugar more per acre per annum than the White Transparent. As ratoons on the four estates for two years, there was an average area of 77 acres of B. 147, and 117 acres of the White Transparent. The B. 147 yielded, on the average, 370 lb. of sugar more per acre per annum than the White Transparent.

Further, with regard to B. 147 at Barbados, I may mention that Mr. Geo. Carrington, the owner of Carrington plantation, has been good enough to give me the average returns obtained on that estate from the White Transparent and the B. 147 for the past four years, i.e., 1903-6 inclusive. For that period there were practically about 200 acres of plants and ratoons of each variety grown each year. During that time, the B. 147 gave, on the average, 398 lb. of sugar more per acre than the White Transparent. This would, in round numbers, amount to about 160 metric tons of sugar for the four years. At £9 per ton for the sugar and its molasses, the gross value would be £1,440. Assuming that the cost of manufacture amounted to £200, there would be left over £1,200 as the profit to the estate for the four years due to this cane being grown.

In 1903, the proprietor of Willis estate in St. Kitt's stated with regard to B. 147 that he had reaped 130 acres in 1902 and 160 acres in 1903. The estate had formerly been materially affected by the ravages of fungus and borer, and he was able to state that in consequence of the introduction of the new varieties of cane, notably B. 147, the output of sugar on the estate had been materially increased, and he was certain that if he put the increase at 33 per cent. he was not overstating it.

At La Vallée estate, in the same island, the same year, the proprietor stated that there were 45 acres of B. 147 planted for the crop each year and 7 acres of White Transparent. Only 52 acres of canes were planted each year, and as B. 147 had done so well, he did not care to try any other varieties. Some fields of B. 147 for the crop of 1902 had given 3 tons of sugar per acre, and none less than 2 tons; for the crop of 1903 he got 3 tons and 2½ tons per acre from plant canes and 2 tons from ratoons.

Towards the end of last month, Mr. A. Cameron was also good enough to send me the following information with regard to the cultivation of B. 147 in British Guiana:—

'You will be interested to know, as grower of the seedling, that in a letter received yesterday from an attorney of a large estate in Demerara, he writes to tell me, that on his estate 40 acres of fourth ratoons B. 147 canes had just yielded an average return of 2·80 tons of sugar per acre.'

With regard to B. 208, I find from Mr. Cousins' report on the sugar experiment work in Jamaica for 1904, that B. 208 gave a return of 66·5 tons of cane per acre, the Bourbon 39 5 tons, and the Mont Blanc 33·8 tons. He stated at the same time: 'The outstanding feature of this year's trials are the splendid qualities of B. 208.' In his report for 1905-6, he says: 'B. 208, appears to be the most promising variety for general cultivation in Jamaica.'

In Queensland, Mr. Edward Grimley, in a paper on the Improvement of Plants, read before the Agricultural Conference held at Queensland in May 1905, writing of B. 208, stated: 'We have now a report from Messrs. Gibson of Bingera which gives a return of 69 tons 6 cwt. of cane per acre with 22 2 per cent. of sucrose and Brix 23·9, or 21·45 per cent. obtainable cane sugar, or over 14 tons to the acre.' He, however, states that these results were obtained with irrigation and the experiment plot was well manured. The average yield for Queensland for the last seven years was 13·16 tons of cane, so that B. 208 had given more sugar than the average tons of cane per acre in Queensland.

In March 1904, Mr. John M. Fleming, of Diamond plantation in British Guiana, stated that for the short grinding just completed, 605 acres of Bourbon and 104 acres of B. 208 were reaped. The Bourbon gave 1 95 tons sugar per acre, and the B. 208, 3 tons per acre, or about 57 per cent. more; and on December 15 last, the same gentleman, writing to the Imperial Commissioner of Agriculture, stated: 'On the 11th instant, we completed our crop of 16,300 tons of sugar for 1906; 6,000 acres were cut an average of 2·176 tons per acre.

'This area of land comprised: –

2,495 acres	Bourbon	at 2·42	tons sugar per acre.
272 ,,	mixed varieties	,, 2 50	,, ,, ,, ,,
3,233 ,,	seedlings	,, 2·96	,, ,, ,, ,,

'Of B. 208, 1,755 acres were cut, at an average of 3 01 tons (metric) per acre.' On the remaining area there were also some of the seedling canes raised in British Guiana by Professor Harrison, C.M.G., and by his late colleague Mr. G. S Jenman

In this case, the B. 208 gave an average of 0·59 metric tons of sugar per acre more than the Bourbon. In other words, 1,755 acres planted in B. 208 gave 1,035 metric tons of sugar more than if the same land had been planted with the Bourbon. At £9, the average value of a metric ton of dark crystal sugar and its molasses at Barbados for the last year, which is just about the average for the past six years, it would mean that this estate made by planting this cane £9,315. Assuming that the cost of manufacture of this extra sugar amounted to £1,315, the plantation made a profit of something like £8,000 from growing this cane.

As I have said above, this estate has been growing seedling canes on practically increasing areas for several years, as will be seen by the following table:

Years.	Bourbon. Acres.	Tons sugar.	Tons sugar per acre.	Seedlings. Acres.	Tons sugar.	Tons sugar per acre.	Increase per cent. over Bourbon.
1901	2,291	6,735	2·81	1,078	3,215	2·99	29
1902	2,791	6,464	2·31	1,317	3,706	2·81	21
1903	2,895	7,194	2·48	1,879	5,331	2·83	14
1904	2,699	6,050	2·24	1,882	5,550	2·95	31
1905	1,539	3,694	2·40	1,121	3,292	2·93	22
1906	2,492	6,038	2·42	3,233	9,570	2·96	22
Totals	15,331	36,175	14·16	10,505	30,664	17·47	139
Averages	2,555	6,029	2·36	1,751	5,111	2·91	23·16

As will be seen from the table, during the past six years the average area in seedlings has been 1,751 acres, and the average percentage of increase during that period of the seedlings over the Bourbon was 23·16 per cent., equal to 2,436 metric tons of sugar. At the average price for sugar mentioned above, the gross value of this would be £21,924, and allowing £2,436 as the cost of manufacturing the sugar, the net revenue to that estate for the period has been over £19,000. In other words, they are better off by that amount from growing seedling canes than if they had planted all the land in the Bourbon. On this one estate, the largest in British Guiana, more profit was derived from Barbados in British Guiana seedling canes in six years than the cost of the sugar-cane experiments at Barbados since they were inaugurated in 1884.

A great deal of this is the outcome of the experiments carried out at Barbados, with which I have been associated from the beginning, and, as will be seen from Tables I-IV given above, the older seedling canes are now surpassed by many others. There is, therefore, no doubt, that in the near future there will be seedling canes cultivated in the West Indies giving yields considerably in excess of the Bourbon and White Transparent canes which are now being generally cultivated in the West Indies.

The new seedling canes mentioned in the body of the report are the result of the work of the Imperial Department of Agriculture, and if my anticipations are realized—and I have no doubt that they will be—the gain to the sugar industry by these new seedlings will repay tenfold the cost of the Department since its inauguration. This, gentlemen, is only a part of what the Department is doing for the West Indian Colonies.

BREEDING HYBRID SUGAR-CANES.

BY F. A. STOCKDALE, B.A., (Cantab.),

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Experiments in the raising of seedling sugar-canes by hybridization under control were commenced at Barbados in 1904. The flowers of one variety were emasculated while young, covered in a muslin bag, and then pollen from another variety was transferred to them. As the result of this work, five stools of hybrid canes of known parentage were obtained and were under investigation during last season. One of these stools suffered very severely during the drought, but two cuttings were obtained from it. At the present time, there are 166 plants growing from the five hybrids obtained, and laboratory tests will be made later to ascertain the saccharose content of their juices. Four pedigree hybrid sugar-canes have also been raised in Queensland, and it is reported that during (1905-6), owing to a favourable season, over 600 hybrids were obtained at the Harvard Experiment Station, Cuba.

In a paper by Sir Daniel Morris, K.C.M.G., and myself, that was communicated to the International Conference on Genetics, held under the auspices of the Royal Horticultural Society during July and August 1906, a concise account was given of the different methods by which improved varieties of sugar-cane had been obtained by selection and hybridization.* Some of the results obtained by those working in this direction were given, together with the individual advances made by some of the more important cane-growing countries. It was pointed out that attempts to procure an improved race of sugar-canes centred around breeding from the best varieties, but it was suggested that in the future the best results were likely to be obtained by first carefully analysing the different characteristics of the different varieties under cultivation, in the hope that it might be possible to pick out desirable qualities from one variety and combine them with other desirable qualities of another variety. The necessity of adopting a method of breeding for definite objects has been brought conspicuously to the front, by the fact that it has repeatedly been pointed out that the breeding ability of the various mother plants varies considerably. Frequently a variety, which is low down in the list in respect to saccharose yield per acre, gives seedlings that are of much more value than a similar race of seedlings produced from a cane that is much higher in the list, or in other words, a cane of comparatively low value often gives a much greater percentage of subsequently selected seedlings than a cane which, in itself, is of a much higher value. In the one case, we have what has been described as a strong 'projected efficiency,' and in

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the other a weak 'projected efficiency.' This variability noticed amongst the offspring has led to considerable confusion, for the plant has been considered as a whole; when each separate character, if taken alone, may be found to obey definite simple laws. Single characters must be treated as distinct, and the composition of individual plants must be considered as much by their progeny as by their ancestry.

In raising new varieties by selection, advantage is taken of the fact that plants raised from seed are never exactly like the parent, while hybridization is often held by some to awaken the sum total of variation in the two parents, with the result that the seedlings thus obtained present many variations. The raising of new and improved races of plants depends upon this circumstance of variability, and it would appear that the differences between separate members of one family are of two kinds: (a) individual differences, usually quantitative, between the various members, such as differences in size of plants or in size of any particular part of a plant—for example a fruit; and (b) definite or qualitative differences, existing between different strains of plants. It is from these definite differences, by a process of hybridization, that new varieties of plants of increased value can be raised.

It has been shown that hybridization of the sugar-cane under control can successfully be carried out. Therefore, instead of depending on raising seedlings by planting arrows from the better varieties, by which only the seed-bearing parent is known with certainty, and instead of making a considerable number of crosses indiscriminately with the hope of obtaining some improvements, hybridization experiments on definite lines have been laid out, in which the different useful characteristics of the several varieties are carefully considered. By this means, the possibility of an individual deviating to a marked degree toward a desired type becoming pollinated with pollen from less desirable varieties is eliminated, and by the careful selection of the varieties to be experimented with there is little chance of a reduction of the standard of perfection already attained.

During recent years, it has been conclusively shown that a general knowledge of the characteristics of different varieties is of the utmost importance, as by such knowledge it is often possible to confine the work to a small number of varieties possessing those desired qualities which are not to be found in other sorts. The physiology of heredity—the manner in which different useful characteristics are handed over from parents to offspring—is becoming more fully understood, and has lately been the subject of exact scientific inquiry. The results, so far obtained, tend to show the value of the technical methods that have been developed by the experience of practical men.

Kobus in Java, in reports issued between the years 1898 and 1901 on the crossing of Java canes, as seed-bearing parents, by natural hybridization with the East Indian variety Chunnee, as pollen-bearing parent, states that 'in some cases the fecundating power of the Chunnee variety is so strong that more than 95 per cent. of the hybrids resemble the male parent,' and

Professor Harrison in a report on the Agricultural Work in the Botanic Gardens and the Government Laboratory, British Guiana, for the years 1896-1901, states that it was being found that 'while the seedlings of the older varieties with but few exceptions show marked tendency to variation, the seeds of canes from seedling canes do not possess this property to anything like the same extent, and in many of these the offspring appears to come fairly true to parentage.' Such records as these on the raising of seedling canes show that some varieties possess characteristics that are transmitted to their offspring, while others do not.

In reference to many other plants it has repeatedly been noticed that when two varieties, which differ by definite characters, were crossed together, the offspring of such a cross partakes to some extent of the different characteristics of either parent, and frequently all to an equal extent. It was further found that if these offsprings were crossed amongst themselves or allowed to self-fertilize, a large number of forms arose in the next or second generation. This was not fully understood until 1901 when the discovery of experimental work carried out by Mendel gave an explanation of the hereditary processes with which the breeder is concerned.

MENDEL'S WORK ON INHERITANCE IN PEAS.

Mendel experimented with the crossing of a large number of peas and centred his attention not on the plant as a whole, but upon its simplest characters, such as shape of seed, colour of flowers, length of stem, etc., and traced in detail the behaviour of each character in the hybrids, keeping the records of these simple characters, singly, separate from all others; for he held that 'in order to discover the relations in which the hybrid forms stand towards each other and also towards their progenitors, it appears to be necessary that all members of the series developed in each successive generation should be, without exception, subjected to observation.'

The exact nature of Mendel's work may possibly be made clear by taking one or two examples from it.

Two varieties of peas were chosen, one of which possessed smooth, round or roundish seeds, while the other possessed seeds that were irregularly angular or deeply wrinkled. These were cross-fertilized. The plants arising from this cross possessed round seeds entirely, of such a form that differences could not be detected between them and the round seeds from one of the parents. It appeared, therefore, that a character of one parent was transmitted complete or almost complete in hybridization to the exclusion of the corresponding character of the other parent. This constituted the character of the hybrids of the first generation, which may be designated by the sign (F. 1). The character which is transmitted is said to be *dominant* to that which is excluded, and the latter may be called *recessive*—roundish form of seeds *dominant* to the wrinkled or angular form.

Now, if plants of the first generation (F. 1) were allowed to self-fertilize themselves and a further generation (F. 2) raised

from the seed they produced, the recessive character—the angular form of the seed—appeared. Twenty-five per cent. of the seeds in this second generation (F. 2) were angular, while 75 per cent. were round or roundish—or a proportion of 3 dominants to 1 recessive.

In the third generation (F. 3), the offspring from the angular seeds of (F. 2) bore nothing but angular seeds, thus showing that the recessive character was constant; while in the offspring from the roundish seeds of (F. 2), which are all so much alike as far as external appearances go, it was noticed that twenty-five out of seventy-five (i.e., 1 out of 3) produced the round character purely, whilst fifty produced both round and angular seeds in the proportion of 3 of the former to 1 of the latter, i.e., 3 dominants to 1 recessive. From this it was seen that some of the round seeds of the second generation (F. 2) bred true to round, while others did not. The former were therefore 'pure' round and the latter 'impure' or 'hybrid' round. It was proved that the 'pure' rounds, through many generations kept true, and showed no reappearance of the angular recessive character. The 'hybrid' rounds, however, produced pure round, hybrid round, and pure angular, just as their parents did.

It was moreover seen that 100 plants from the progeny of the hybrid of (F. 2) consisted of twenty-five pure recessive, twenty-five pure dominant, and fifty similar in constitution to the hybrid form, since they gave offspring of the same character in the same proportions.

This can be shown diagramatically as follows :—

ROUND × ANGULAR (OR *vice versa*).

F. 1. all round.

F. 2. 3 round. 1 angular.

F. 3. 1 pure round. 2 impure round. 1 angular. angular.

F. 4. pure round. 1 pure round. 2 impure round. 1 angular. angular. angular.

In further generations a similar result was obtained and other characters were found to behave in a like manner. In peas it was found that tallness is dominant to the dwarf habit, the round shape of the seeds dominant to the angular form, etc.

The exact results may be given in the abreviated form—D. being written for the dominant character and R. for the recessive- and is applicable for any pair of similar characters :—

D. CROSSED WITH R.

F. 1. DR. (hybrid, in appearance D.)

F. 2. D. 2 DR. R.

(in appearance D.)

F. 3. D. D. 2 DR. R. R.

F. 4. D. D. D. 2 DR. R. R. R.

Experiments subsequently conducted by Bateson, Saunders and others for the Evolution Committee of the Royal Society, and by Biffen and others on wheat breeding have given similar results. It is, therefore, concluded that the *gametes*—the male and the female germ-cells—are pure with respect to the characters they carry, and assuming that an approximately equal number of pollen grains and egg-cells carry either one or other of the characters, the numercial relations observable in the progeny of the hybrids find a simple explanation; for according to the law of probability, when self-fertilization occurs in a DR. form, if the gametes bear either one of the characters in approximately equal numbers, the chances are that a D. pollen grain may meet with a D. or R. egg-cell, giving rise to a form either with dominant characters alone or to a hybrid, i.e., a D. or a DR; while an R. pollen grain may meet with an R. or a D. egg-cell and give rise to R. or DR. forms. No other combinations are possible, and, therefore, the progeny would be represented by a series of individuals of the following forms: —D. + 2 DR. + R.

The D. and R. forms breed true, as their gametes carry only dominant or only recessive characters, whilst the DR. forms produce on self-fertilization the D. + 2DR. + R. series again.

We have considered, as yet, only varieties different in simple characters; but varieties differing in two or three pairs of characters have been experimented with, and it has been found that the gametes carry each of these characters pure.

If a plant having seeds round and yellow were crossed with a variety having seeds angular and green, definite results would be obtained. We may indicate roundness of seeds by A. and the angular character by a., as roundness is dominant to the angular form, and yellowness by B. and greeness by b., as the yellow character is dominant to the green one. We may consider the first character (shape of seed) and get in F. 2, A + 2Aa + a, while if we consider the second character (colour of seed) we get in F. 2, B + 2Bb + b. Now the total number of

combinations that the gamotes can make will be obtained by mutiplying together $(A+2Aa+a)$ and $(B+2Bb+b)$; the result of which is $AB+Ab+aB+ab+2ABb+2AaB+2Aab+2aBb+4AaBb$.

There are, therefore, nine types possible, but externally they appear as four, namely, round yellow, round green, angular yellow, and angular green, in the proportion of 9 : 3 : 3 · 1; as AB, 2aB, 2ABb, and 4AaBb, have the appearance AB – 9; Ab, and 2Aab are of the appearance Ab – 3; aB, and 2aBb are of the appearance aB = 3; and ab = 1.

Mendel next tested the truth of his hypothesis that both male and female cells were pure, by crossing the first cross hybrid with pure dominant and pure recessive forms, respectively. It was found that DR. crossed with D. gave DD.: DR. as 1 : 1, and that DR. crossed with R. gave DR.: RR. as 1 : 1.

EXPERIMENTS IN BREEDING SUGAR-CANES.

In cases that follow Mendel's Law, the processes of plant breeding are definite and exact, viz., the characters existing in the parents are transferred in their full intensity to descendants of the hybrids, recessives bred true from the moment of their appearance but only one-third of the individuals showing the dominant character breed true, and a further generation has to be raised before the pure dominants can be picked out. A number of examples have been noticed which do not behave along exactly similar lines. The characters may blend, giving an intermediate form, which may breed true or may give the parent forms among its offspring in the second generation. Other instances have occurred in which a totally new character has made its appearance which may or may not follow Mendel's Law, while whole series of new forms, apparently not combinations of visible parental characters, may appear.

The problem we have to face is this—Can the breeding of the sugar-cane be conducted upon the same lines as the breeding of new varieties of peas or wheat; is it possible, so to speak, to pick out the valuable characters from different varieties, and gradually build up an ideal type? This, of course, can only be shown by experiment, and consequently a series of experiments is being started in which definite crosses will be made with a view to ascertaining how the different characters desired are transmitted to the offspring. The sugar-cane is built up of a series of characters, the inheritance of which must be traced independently of each other.

A thorough knowledge of the varieties to be experimented with is the first requisite, and then it is necessary to decide what characters are to be worked with. Only those varieties of sugar-cane that have been tested under varying conditions of soil and climate have been chosen for experiment, for the securing of good parents is very important as the number of varieties for experiment has to be limited. Only those characters which are of economic value, and which appeal to the planter, will be considered at the outset. It is hoped before long that definite results will be obtained, and that some

knowledge will be gained of the different characters that will be considered in the experiments, viz., tonnage of cane per acre, richness of juice, and resistance to disease.

TONNAGE EXPERIMENTS.

For the tonnage experiments, six varieties, that have been under test for some time, have been chosen, viz., B. 1,753, B. 4,164, B. 4,028, B. 3,390, D. 95, and Queensland Creole. The first four have shown themselves to give a large tonnage per acre, while the last two are small tonnage canes. These varieties have been planted in four rows, twenty-five holes deep, and arranged according to a definite plan, so that any single variety can be crossed with any other. There will therefore be 100 holes of each variety. The rows run in the following order: B. 1,753, D. 95, B. 4,164, Queensland Creole, B. 4,028, B. 3,390, B. 4,164, B. 1,753, D. 95, B. 4,028, Queensland Creole, B. 3,390, B. 1,753, Queensland Creole, B. 4,164, B. 4,028, D. 95, B. 3,390, B. 1,753, B. 4,028, Queensland Creole, D. 95, B. 4,164, B. 3,390.

It will be possible, therefore, if the varieties arrow, to make the following crosses: large tonnage crossed with large tonnage, large tonnage crossed with small tonnage, and small tonnage crossed with small tonnage. In this way it is hoped to ascertain whether tonnage of cane is a character that is transmitted to the offspring and whether certain varieties are of greater value in this respect than others.

It is expected that the sugar-cane can be considerably improved in the direction of increased tonnage, especially when it is held that a larger tonnage of cane per acre depends largely upon increased vigour of the cane, for hybrids are generally more vigorous than their parents.

JUICE EXPERIMENTS.

Cousins, Jamaica, holds that 'beyond a certain point—24 per cent. saccharose in the juice— any increase in richness involves a reduction in agricultural yield,' but as only a few of the varieties now under experiment possess over 20 per cent. saccharose in the juice, maximum productiveness has not been obtained, and therefore experiments to inquire into the quantity of saccharose in the juice as a distinctive character of the sugar-cane have been laid out on the same plan as the tonnage experiments. Six varieties, viz., B. 3,675, B. 208, B. 3,922, T. 24, B. 3,746, and B. 4,164 have been chosen for the experiments, the first four possessing rich juice and the last two poor juice. Each of the varieties has been planted in four rows —twenty-five holes deep— and arranged in the following order: B. 3,675, B. 3,746, B. 208, B. 4,164, B. 3,922, T. 24, B. 208, B. 3,675, B. 3,746, B. 3,922, B. 4,164, T. 24, B. 3,675, B. 4,164, B. 208, B. 3,922, B. 3,746, T. 24, B. 3,675, B. 3,922, B. 4,164, B. 3,746, T. 24. These varieties have been laid out on a plan similar to that of the tonnage experiments and have been arranged so that different crosses can be made—rich-juice canes with rich-juice canes or with those having poor-juice, and the poor-juice canes among themselves.

DISEASE EXPERIMENTS.

A similar plan of experiments has been laid out to inquire into the disease-resistant power of various varieties, as it is possible that increased vigour of a plot of canes as reflected in larger yield of sugar is accompanied by greater immunity from disease. The root disease is probably the one that, at the present time, is causing a considerable amount of damage in the West Indies. Large losses have certainly been incurred by this disease in Barbados, and therefore it is the one to which attention will be paid. Four varieties, viz., B. 6,048, B. 1,529, B. 3,289, and B. 208 have been chosen as those which are either entirely immume or suffer little from the attacks of the fungus that causes this disease, and will be arranged with two others, B. 3,668 and B. 3,696 that appear to suffer severely from this cause.

These are planted on precisely the same plan as the tonnage and the juice experiments, in the following order:—B. 6,048, B. 3,668, B. 1,529, B. 3,696, B. 3,289, B. 208, B. 1,529, B. 6,048, B. 3,668, B. 3,289, B. 3,696, B. 208, B. 6,048, B. 3,696, B. 1,529, B. 3,289, B. 3,668, B. 208, B. 6,048, B. 3,289, B. 3,696, B. 3,668, B. 1,529, B. 208. The offspring of the crosses made will be tested for resistance against the root disease, and if sufficient disease is not present for tests from natural infection, artificial inoculations or injections will have to be resorted to.

COMBINATION—TONNAGE AND JUICE—EXPERIMENTS.

The above three series of experiments have been established for the purpose of investigating different characters singly, but an effort will be made to examine closely a combination of two characters, with a view to obtaining definite knowledge as to the behaviour of these characters in several different varieties of sugar-cane on hybridizing. Owing to the small space available for the conduction of these experiments and to the limited time during which it is possible to carry out the emasculation of the flowers, only twelve varieties have been chosen, and 100 holes of each variety set out. The canes are planted in chess-board fashion in rows twenty-five holes deep, and arranged so that any variety can be crossed with two others. The following varieties have been chosen:—B. 1,753, B. 3,289, B.3,922, B.6,048, B.1,529, B.4,769, B.4,844, B.4,164, B.208, B.1,566, B.3,890, B.3,675. Table I gives an outline of the crosses that it is proposed to make. An analysis of the characters of the different varieties chosen is also given, where R = rich juice, r = poor juice, T = large tonnage, and t = small tonnage.

Of course, it must be clearly understood that the different characters put forward in this table are not of the same value, for they vary slightly in different years, but they are held to be comparative. For example, B. 1,753 gave in 1903-5 an estimated yield of canes of 50·17 tons, while B. 3,289 only gave 42·34 tons; but these tonnage yields must be considered large against 28·92 tons of B. 1,529 and 29·88 tons of B. 4,844. The first are, therefore, designated by T. while the last are indicated by t. The same is the case with the juice of the different varieties.

TABLE I.

Combination—Juice and Tonnage—Experiments.

B. 1,753 (r T)	to be crossed with	B. 6,048 (R T) B. 1,566 (r T)
B. 3,289 (R T)	„ „ „	B. 6,048 (R T) B. 3,675 (R t)
B. 3,922 (R t)	„ „ „	B. 4,844 (r t) B. 1,529 (R t)
B. 6,048 (R T)	„ „ „	B. 1,753 (r T) B. 3,289 (R T)
B. 1,529 (R t)	„ „ „	B. 3,922 (R t) B. 4,164 (r T)
B. 4,769 (r t)	„ „ „	B. 3,390 (R t) B. 4,844 (r t)
B. 4,844 (r t)	„ „ „	B. 4,769 (r t) B. 3,922 (R t)
B. 4,164 (r T)	„ „ „	B. 3,390 (R t) B. 1,529 (R t)
B. 208 (R t)	„ „ „	B. 3,675 (R t) B. 1,566 (r T)
B. 1,566 (r T)	„ „ „	B. 208 (R t) B. 1,753 (r T)
B. 3,390 (R t)	„ „ „	B. 4,164 (r T) B. 4,769 (r t)
B. 3,675 (R t)	„ „ „	B. 3,289 (R T) B. 208 (R t)

The planting of the varieties in chess-board fashion has been practised in order to make crossing as easy as possible, and the following table illustrates the arrangement adopted :—

TABLE II.

Chess-board Planting taken from the Combination—Juice and Tonnage—Experiments.

B. 1,753	B. 6,048	B. 1,753	B. 6,048	B. 1,753	B. 1,566	B. 1,753	B. 1,566
x	x	x	x	x	x	x	x
B. 6,048	B. 1,753	B. 6,048	B. 1,753	B. 1,566	B. 1,758	B. 1,566	B. 1,753
x	x	x	x	x	x	x	x
B. 1,753	B. 6,028	B. 1,753	B. 6,048	B. 1,753	B. 1,566	B. 1,753	B. 1,566
x	x	x	x	x	x	x	x
B. 6,048	B. 1,753	B. 6,048	B. 1,753	B. 1,566	B. 1,753	B. 1,566	B. 1,753
x	x	x	x	x	x	x	x

Continued to twenty-five holes deep.

The varieties have all been carefully studied and have been chosen as being the best we have on hand at the present. Careful systematic work, conducted along definite lines, is to be carried out in order to analyse the different qualities of the sugar-cane and to incorporate as many of the best characteristics as can possibly be brought together in a single variety in order to fulfil a certain and definite purpose. Arrows of the various varieties will also be bagged separately to obtain self-fertilized seedlings, in order to investigate, if possible, the dominant characteristics more fully, for it is suspected that some, if not many, of the varieties chosen may be impure or hybrid types. This will considerably complicate matters, but difficulties will have to be met.

Small numbers of seedlings can only be obtained owing to mechanical difficulties in emasculation and cross-pollination, on account of the small size of the flowers and the height of the arrows above the ground, to the varied time of arrowing and often to a total lack of arrows, as well as to unfavourable climatic conditions. It is hoped, however, that in a few years, canes will be built up, character by character, that will stand the rigorous test of field selections and analyses in the laboratory.

A systematic investigation of the material on hand in order that somthing definite may be learned about the unit characters with which we intend to deal, their dominance, and their combination and correlation with other characters is to be undertaken. With this fundamental work accomplished, it may be possible to deal with varieties, concerning whose characteristics something definite is known, and to prosecute the work of sugar-cane breeding in definite directions and to secure results previously planned for.

OTHER EXPERIMENTS FOR PRODUCING HYBRIDS.

The difficulties of obtaining large numbers of hybrids by hybridization under control have been mentioned previously, and, as the access of pollen from an unknown source must be recognized as being detrimental to advancement in hybridization work and as it would lead to entirely erroneous conclusions, a series of experiments by which it is hoped to obtain hybrids by what may be called natural hybridization has been started.

It has been well known for some time that certain varieties of the sugar-cane produce much fertile pollen while the pistil is normal, and others produce little or none. Advantage of this fact has been taken by the experimentalists in Java, and large numbers of hybrids have been obtained by planting in alternate rows varieties that arrow at the same time—one of which may be called 'male', possessing much fertile pollen, and the other 'female', possessing a very small proportion of fertile pollen. The arrows from the 'female' variety alone are cut, and the resulting seedlings must be the result of a cross or of self-fertilization, and the chances, under

Java conditions, are such that the 'male' variety planted in the adjoining rows is generally held to have provided the pollen.

With the high winds that prevail in the West Indies it is thought that such a method cannot be satisfactorily practised, but it is hoped that, if varieties 'male' and 'female'—be planted in chess-board fashion and an arrow producing much normal pollen be bagged with an arrow producing little fertile pollen at an early stage, before outside pollen from an unknown source can be blown upon the stigmatic plumes of the 'female' variety, a number of seedlings can be obtained of known parentage. After a sufficient time has elapsed for pollination the 'male' arrow would be taken out and only the 'female' arrow sown.

It is possible that some seedlings would be the result of self-fertilization, as sometimes the 'female' canes produce a few normal pollen grains; but in these varieties the chances of self-fertilization are reduced to a minimum and, therefore, if fertile seeds are produced by these canes they will almost certainly be the result of hybridization. By this method, access of pollen from an unknown source cannot take place, and the risk of obtaining large numbers of seedlings of less value than the female parent will be largely reduced.

At the Dodds Experiment Station, Barbados, plots have been laid out to test this method. Canes that have stood the stringent test for a number of years have been selected. B. 376 has been planted chess-broad fashion with B. 208, and White Transparent is to be crossed with B. 3,289 : 2½ acres have been planted in all. White Transparent and B. 376 produce little fertile pollen, and therefore, any seedlings obtained from them should be the result of crossing, and an advance made in the desired direction.

It is hoped that this method may give results that would justify its adoption on a larger scale, and be the practical method of gradually improving the sugar-cane along scientific lines.

CONCLUSION.

In conclusion, it will be seen that definite plans have been laid out by this Department for the breeding of hybrid sugar-canes, as it is expected that considerable improvement can be made. The experiments have been started on a small scale, as it is necessary to become as fully acquainted as possible with the characters of different chosen varieties, in order that the inherent tendencies for utility may be understood, and so that the life forces of the best varieties may be directed into useful channels. Records of pedigrees, relative values of hybrids, dominance of characters, etc., will have to be kept and arranged in such a way that the value of any individual may be seen at a glance. It is possible that, in hybridization, totally new characters may make their appearance which may prove of value and possibly different characters of the parents may show blending, but until experimental evidence is obtained nothing can be said of what results will follow. Several years must elapse before sufficient varieties have been raised and

submitted to rigorous field and laboratory tests, before recommendations can be made to the planters. Plant breeding has been put upon a definite basis, for it has been shown that, with the proper understanding of the inheritance of the unit characters, new varieties can be built up with certainty, by picking out and combining together characters already existing in other varieties. Improvements can be made by picking out a desirable feature here, another there, and combining them together. It is expected that hybridization will be the means of making rapid improvement in the sugar-cane, and it is hoped that among the hybrids there will be some that will not be found wanting when the final tests are made.

THE RATIONAL USE OF MANURES FOR SUGAR-CANE IN JAMAICA.

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One of the special peculiarities of Jamaica as a sugar-producing country, is that of the great diversity of soils and climates to be found in the various sugar-producing areas. Any attempt at generalization is therefore quite out of the question, more especially on such a matter of local requirement as the use of manures.

It is on this account that I have not considered it desirable to carry out at the Sugar Experiment Station any elaborate series of manurial experiments, as has been done with such success in Demerara, Barbados, and the Leeward Islands. Our conditions at Hope are so entirely different to those in Vere, Westmoreland, or the north side of the island, that any results obtained there as to the manurial requirements of the sugar-cane would be quite inapplicable to the other sugar districts.

We have, therefore, been forced to restrict ourselves to co-operative experiments on the estates; and although the limitations and drawbacks of such experiments are obvious, useful information applicable to local conditions is nevertheless obtainable.

Speaking generally, it may be said that the use of fertilizers in those districts where droughts are prevalent and irrigation is unobtainable is purely a gamble against the weather.

If a good growing season should prevail, fertilizers may pay well, whereas in a drought they may prove entirely unremunerative, and in some cases even accentuate the damage done by severe drought.

Where irrigation is obtainable, or when normal seasons favourable for the growth of the cane prevail, the use of manures becomes a matter of practical importance.

LIME.

Lime is frequently the most needed amendment of our sugar-cane soils, and in our experiments nothing has, on occasion, exerted such a remarkable influence on the returns of cane as this material.

On soils in which the lime is deficient, ½ ton of lime per acre should be applied broadcast each year, preferably before the first deep cultivation. At Amity Hall, 5·4 tons of canes, and at Hillside, 12 tons of canes per acre were obtained by the use of ½ ton of lime per acre in the Vere experiments.

The use of large dressings of lime on a tropical soil is not to be recommended owing to the set back which is thus given to the nitrifying processes in the soil. It would appear that 10 cwt. of lime per acre once a year is an ample quantity for manurial purposes.

Where marl is used a larger quantity—say 4 or 5 tons per acre—is required. Some types of marl are injurious to the soil, and lime is, on the whole, the best form in which to make good a deficiency of this ingredient.

HUMUS.

The chief problem of tropical agriculture is the maintenance of a suitable standard of humus in the soil. The process of decay, rapid under any circumstances in the tropics, becomes greatly accelerated by tillage and stirring of the soil.

In the case of sugar-cane cultivation in Jamaica much reliance is placed upon fly-penning, and upon the use of cattle manure. On many estates, however, it has been found that cow peas can be used with good effect to increase the supply of humus. A very vigorous variety of cow pea has been cultivated at Money-musk estate in Vere, and seeds of this variety were obtained by the station for distribution to estates. Lime and cow peas are quite sufficient in many cases to assure a full crop of cane.

The history of large sugar enterprises in other tropical countries indicates that where steam is used in place of animal traction for estate purposes, a deterioration of the cane lands is very apt to result. It would seem desirable in Jamaica to rely on animal traction as much as possible in any large sugar enterprise, so that a good supply of manure might be secured for reinforcing the fertility of the cane fields.

NITROGEN.

Owing to the rise in the price of nitrate of soda during the past few years, the cost of nitrogenous manures to the planter has increased, and as this is the limiting factor in the productive power of most soils for growing a crop of sugar-cane, the

economic maximum for the supply of nitrogen is the most important matter for consideration in any system of fertilizing the cane fields.

For purposes of convenience I am inclined to favour sulphate of ammonia as a concentrated source of nitrogen for use in Jamaica. Nitrate of soda is more liable to be leached, and is not so convenient for mixing with other manures. The price of sulphate of ammonia varies, but may be taken at about £13 per ton, c. i. f., Jamaica. It has been found desirable to import it in barrels, as the free acid it contains is very apt to rot the bags in which it is generally packed.

Dried blood, guano, and meat-refuse manures are also of use as sources of nitrogen for canes, but, in our experience, are not so efficient as sulphate of ammonia for the same outlay of money.

From 1 to 2 cwt. of sulphate of ammonia per acre has been found profitable in Jamaica under varying conditions.

PHOSPHATES.

The cultivated soils of Jamaica are peculiarly rich in available phosphoric acid and there are many sugar soils where the store of phosphates is largely in excess of any possible requirements of the crop. I am of opinion that most of the mixed manures that are prepared for sale to sugar planters contain an excess of phosphates in proportion to other ingredients for the economical requirements of our soil in Jamaica. Professor Harrison has demonstrated that soils in British Guiana with a content of available phosphoric acid above the normal do not need phosphatic fertilizers.

There are three classes of soil in Jamaica each requiring a different form of phosphatic fertilizer. For all the stiff soils and those of medium texture deficient in carbonate of lime, basic slag is the best form of phosphate. For the soils rich in carbonate of lime (0·5 per cent. and over), superphosphate should be used, while on the light alluvial soils deficient in carbonate of lime, the best results have been obtained from a mixture of 2 parts steamed bone flour and 3 parts of good superphosphate.

Basic slag must not be mixed with sulphate of ammonia, and superphosphate is incompatible with nitrate of soda in a mixture.

POTASH.

Some sugar soils that have been long in cultivation, would appear to be very deficient in potash. Sulphate of potash, costing about £12 per ton, c. i. f., Jamaica, is the most convenient source of imported potash. Profitable results have followed the application of ½ to 1 cwt. of sulphate of potash per acre. Wood ashes, if unleached, supply potash in a peculiarly useful form, and should always be carefully stored on the estate so as to avoid loss of potash.

MIXED MANURES FOR CANES.

With a few exceptions the mixed manures supplied to planters are sold at a price of 10 to 30 per cent. higher than the cost of the ingredients. Some contain low-grade nitrogenous materials and are therefore of less value than would appear from the guaranteed content of nitrogen.

A good deal of an American packing house fertilizer has been used by planters during the past season, containing phosphates and nitrogen in fair proportion. The results of the manure as seen in the fields, appear to have been satisfactory to several buyers, but the cost was quite 25 per cent. higher than that of the same ingredients imported direct from Glasgow for the use of the Sugar Experiment Station.

SUMMARY.

There are soils on which sulphate of ammonia used alone is the most profitable application, and others for which ammonia and potash, or ammonia and phosphates are desirable, and again other soils appear to require a complete manure of nitrogen, phosphate, and potash.

The wisest policy is for each planter to study the indications of the field experiments which are now available to every estate desiring to carry them out, and to adopt the manure indicated as most profitable for application to his peculiar soil. The importation of high-grade materials purchased at ruling market prices would in many cases save a quarter of the present outlay on imported manures.

THE NITROGEN CYCLE AND SOIL ORGANISMS.

BY S. F. ASHBY, B.Sc.,

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During the last twenty years much has been done towards clearing up the changes which the element nitrogen suffers in its relation to the soil and vegetation. It was until quite recently believed that the inert gas which constitutes four-fifths of the air was practically a changeless reservoir of indifferent matter which was brought into combination with oxygen in occasional trifling amounts during electric discharges. This combination was supposed to make good, slight losses whereby the element might, under unknown conditions, become free again, so that the fund of combined nitrogen in the world remained constant, working round in a cycle through the organic and inorganic kingdoms practically independent of the great free reservoir in the air.

Thanks, however, to the work of agricultural chemists, and plant physiologists, as well as that of microbiologists, it is now known that the free nitrogen of the air is constantly being brought into combination on a large scale through the agency of certain organisms, and that it is also being set free again on a large scale by the agency of other organisms.

It is the amount of combined nitrogen in the soil which, given suitable physical conditions, determines in a large measure the yields of our crops, and it has always been one of the objects of a successful agriculture, though in an unconscious way, to encourage and turn to account this process of combination, and as far as possible to combat and discourage the process which turns the nitrogen back into the air as free gas again. Broadly speaking, this has been achieved by the growth of legumes for animal food or for green manuring, and by drainage and rational cultivation of the soil.

To understand the working of these two end processes, a short account of each of the main changes undergone by nitrogen will be necessary.

In the first place, a few words may be said about the organisms of the soil. These consist, in addition to the familiar green plants visible to the unaided eye, of various forms of green plants, called algae, which can be seen only with the aid of the microscope. The vast number of soil organisms are, however, colourless; mostly bacteria, a few moulds, and still fewer yeasts.

From the standpoint of the nitrogen cycle, all these organisms are important; but in virtue of their numbers, kinds, and activities, the bacteria easily take the first place. They consist of single cells which multiply by simple division, and are as a rule either spherical or rod-shaped. They are extremely small, rarely exceeding $\frac{1}{5000}$ inch in length, and are often not more than $\frac{1}{25000}$ inch, so that one need not be surprised to hear that an ounce of a good soil to a depth of

1 foot contains about ten millions. At a depth of 3 feet they are much less numerous, and at 6 feet are often entirely absent, the soil acting as a filter. If some soil is heated for an hour or more at 250° F. in contact with steam, the organisms are all killed out. The same end can be attained, though with more difficulty, by treating the soil with poisons like corrosive sublimate or carbolic acid, or with the vapours of chloroform, carbon bisulphide, etc.

By treating soils in one of these ways to kill the life in them, it has been possible to prove that none of the changes about to be described, take place by purely chemical means, but only when the bacteria and other organisms are alive and active.

We can now turn to the first step in the nitrogen cycle—the bringing into combination of free nitrogen gas.

THE BRINGING INTO COMBINATION OF FREE NITROGEN GAS.

Nearly twenty years ago, Hellriegel and Wilfarth published their results on vegetation experiments from which one could only conclude that leguminous plants, such as peas, beans, clover, etc., are able to get their nitrogen from the air.

It has now been proved, beyond doubt, that it is the bacteria living in the nodules on the roots of these plants which bring the atmospheric nitrogen into combination. Mazé and Golding have been able to cause these bacteria, separated from the plant, to fix nitrogen from the air in an artificial culture liquid. Special cultures of these organisms have proved of great value both in the United States and Germany for inoculating seed or soil, where virgin land has been broken up, for sowing alfalfa or serradella. In soil which has been long under cultivation they are generally present, and inoculation would probably only be profitable where a leguminous plant new to a country was being introduced. Under ordinary conditions leguminous plants are rarely without root nodules, and, consequently, the bacteria which fix the nitrogen.

By this means, an enormous amount of nitrogen is being annually obtained from the air by one of the largest and most widely distributed of all orders of plants. In Jamaica, it is easy to see that the leguminous order provides a large part of the vegetation, from great trees down to herbaceous weeds.

In all tropical countries, where the people are mainly vegetarian, the seeds of legumes, always rich in meat equivalents, are one of the most valued food staples; for instance, the gram peas and soy beans of the East. It is certain that the bulk of the nitrogen in these seeds comes from the air. In the tropics, where the rainfall is not sufficient for high forest and formation of humus, nor so scanty as to induce desert conditions, vegetable matter decays very rapidly, especially in the lighter soils which are easily exhausted of their combined nitrogen. Under these conditions, the fixation of nitrogen by legumes, in conjunction with the nodule bacteria, is a property which greatly favours the development of these plants.

At about the same time as nitrogen fixation was observed in the above mentioned case, the French chemist Berthelot was able to prove that uncropped soils, when kept moist and exposed to the air, showed, after several months, considerable gains in combined nitrogen, and as this did not occur when the microbes have been killed in them, he concluded that certain soil organisms must be able to bring nitrogen into combination quite independent of any green plant. A few years later, a bacterium which was capable of growing in a sugar solution, containing no combined nitrogen, and, in the absence of oxygen, of fixing small quantities of nitrogen gas, was isolated from soil. The sugar was broken down into butyric acid, carbonic acid, water, and hydrogen, and for every 1,000 parts so decomposed about 2 parts of nitrogen were fixed.

About four years ago another organism was obtained from soil which grew vigorously in sugar solutions when in the presence of abundant oxygen, but in the absence of combined nitrogen. The sugar was oxidized to carbonic acid and water, and for every 1,000 parts so broken down as much as 10 parts of nitrogen were fixed. The writer has repeatedly isolated this organism from English arable soils, once from an Egyptian soil, and an allied variety from East, and South African soils, the latter differing from the other by producing a blue and finally golden yellow diffusible pigment.

An organism quite similar to the English type has been isolated by him from a Jamaican cane soil, with similar nitrogen-fixing properties. It has been impossible, however, up to the present, to find this organism in old pasture and old meadow land showing an acid reaction, but it is always abundant in cultivated soil containing carbonate of lime.

For obtaining it from the soil, a solution of the following composition has been found very favourable :-

Mannite or Glucose...	12	grammes.
Di-potassium phosphate	·2	„
Magnesium sulphate	·1	„
Sodium chloride	·1	„
Distilled water	1	litre.

If about 100 c.c. of this solution, to which ½ gramme of precipitated carbonate of lime has been added after sterilization, is put into a flask in a shallow layer, inoculated with a gramme of fresh arable soil, and exposed to a temperature of 80-90° F., in the dark or in diffused sunlight, a strong film of the organism will develop in about three days, which is never quite pure. Isolated colonies can be obtained by transferring some of this film on to an agar of the same composition.

In pure cultures the fixation of nitrogen is never so large as in the first crude culture from the soil. The organism is an unusually large coccus, two- to four-thousandths of a millimeter in diameter, often occurring in the film as diplococci, and staining a fine red-brown with iodine in potassium iodide. It takes up aniline stains with great intensity, and is consequently very rich in albuminous matter. An old film on a liquid, or the growth on agar becomes brown, and finally often black.

This organism from the soil is very feebly motile, and only shows that property in young cultures.

Beijerinck, the discoverer of the bacterium, has named it *Azotobacter chroococcum*, and he has also described another species, *Azotobacter agilis*, which he found in a canal water, but distinguished by its larger size and intense motility. The writer has also found this species forming an almost pure film on the surface of a marked mixture of dunder and molasses which had been set up for a butyric fermentation six months earlier, after being sterilized and inoculated with a pure culture of a butyric organism. Rain had, however, got in and doubtless brought this organism with it. There was no longer sugar present, but only the calcium salts of lactic, butyric, and acetic acids. That these salts were undergoing rapid oxidation by the *Azotobacter* was shown by the continuous separation from the liquid of a calcium carbonate precipitate.

The first visible product of nitrogen fixation is the albuminous substance of the organism itself, neither ammonia nor oxidized nitrogen being present in the medium. The organism obtains the energy for fixation from the oxidation of the sugar, which yields an amount of energy enough to fix more than ten times as much nitrogen as has ever been obtained in artificial cultures. In the case of the leguminous plants, the sugar formed in the leaf is the source of energy for the nitrogen fixed by the bacteria of the nodules, which show, otherwise, no resemblance to the *Azotobacter* species.

It is easy to show that soils contain also butyric organisms capable of fixing nitrogen in sugar solutions, by using the same sugar solution as that for the culture of *Azotobacter*, but exposed to an atmosphere of nitrogen (best obtained by absorbing the oxygen with alkaline pyrogallate) at a temperature of 90-100° F. An active fermentation sets in, but less than one-third of the nitrogen is fixed for the same amount of sugar decomposed, as in the case of the *Azotobacter*.

As yet, one knows very little with regard to the amount of nitrogen practically brought into combination by these free, living organisms in soils, and one is, therefore, not in a position to estimate their value for agriculture.

Mr. A. D. Hall at the Rothamsted Experiment Station, England, has recently found that two soils which had been allowed to run wild for twenty years had gained very greatly in combined nitrogen during that period to a depth of at least a foot, the gain being much the greater, however, in the one containing much calcium carbonate from which the writer obtained *Azotobacter* abundantly, than in the other where carbonate of lime was absent, and from which only butyric bacteria could be cultivated.

Several observers have remarked a considerable increase of combined nitrogen in the surface layers of soils on which an abundant growth of microscopic green algae had formed, and it was concluded, somewhat hastily, that they also had the power to fix nitrogen from the air. Pure cultures of the algae have, however, shown no such ability, but fixation has occurred when they were allowed to grow in conjunction with soil

bacteria. This suggests a symbiosis between the green algae and the bacteria of the *Azotobacter* type, similar to that between the green leguminous plant and its nodule bacteria, the sugar formed by the algae with the aid of sunlight becoming available for oxidation by the bacteria with consequent fixation of nitrogen by the latter.

Under whatever conditions the nitrogen of the air becomes combined, the first visible product is always the albuminous matter constituting the bodies of the active organisms, and indirectly, of the leguminous plant. On the death of these bodies, this matter undergoes great changes, due to the activity of other soil organisms, and this brings us to the next step in the nitrogen cycle.

THE BREAKING DOWN OF ALBUMINOUS MATTER.

This takes place under two broad conditions, in the presence of abundant air, and, consequently, of oxygen, and in the absence, or in a very restrictive supply, of air. In the first case, one speaks of decay, in the latter case of putrefaction. Decay of albuminous matter takes place in the well aerated surface soil which is frequently stirred by agricultural implements, and is characterized by the production of ammonia, carbonic acid, and water. This process is entirely the work of bacteria and moulds, mainly of the former. If one inoculates a one-part-per-thousand solution of peptone with a little soil, and then exposes it to the air in a shallow layer at about 80 F., one will find that after a few days, at least half the nitrogen of the peptone has been converted to ammonia, and the liquid is strongly clouded by countless bacteria. If air had been excluded, putrefaction would have set in and been characterized by the production of evil-smelling substances, ammonia being formed only very slowly. Decay is, therefore, a greatly more rapid and more effective process than putrefaction. Ammonia, however, does not accumulate in a cultivated soil, but suffers a change under the influence of bacteria. This bring us to the next step in the nitrogen cycle.

NITRIFICATION.

This consists in the oxidation of ammonia to nitrate in two stages by two quite distinct species of bacteria. The ammonia is first converted by the one species to a nitrate, and the latter then oxidized by the other species to a nitrate. This process can only occur when there is an abundant supply of air, and is therefore most active near the surface of the soil. The writer has found that, under English conditions, nitrification is nearly as active at a depth of 8 inches as at 4 inches, but only about half as active at a depth of 12 inches from the surface.

In order that the process may go forward, some basic substance must be present in the soil. This is usually carbonate of lime. This converts the ammonia into carbonate, which is then oxidized to nitrate of ammonia which reacts with more carbonate of lime with the formation of calcium nitrate and ammonium carbonate, the latter being again nitrified.

Neutral solutions of ammonium salts, like the sulphate and chloride, undergo no nitrification whatever when inoculated with a little soil, but the process can be started by the addition of a little carbonate of lime. The writer has found that ferric hydrate or iron rust can replace the carbonate to a certain extent.

In acid soils nitrification cannot occur. The author found this to be the case with the acid turf of an old meadow down to 8 inches, but in the mineral soil below, at 12 inches, nitrification was fairly active, and was even taking place at a depth of 28 inches.

These two nitrifying bacteria are remarkable for the fact that they will grow and nitrify in a purely mineral medium, as they are both able to use the energy set free by the oxidation of ammonia and nitrate, respectively, to decompose the carbonic acid in the air, the carbon entering into the organic substance of their bodies.

If a little fresh soil is used to inoculate a solution containing ½ gramme of ammonium sulphate in a little distilled water to which potassium phosphate and magnesium sulphate have been added, together with some carbonate of lime, then, in the course of a fortnight, at a temperature of 80-90° F., nitrite will be found in the liquid, which, after increasing in amount for some days, will begin to diminish, and finally disappear, giving place to nitrate. The latter will only begin to appear when the ammonia has been largely oxidized to nitrite. This is due to the fact that ammonia prevents the nitrate organism from oxidizing the nitrite formed by the other bacterium. The writer has found, however, that ammonia prevents the growth of the nitrate organism, but when the latter has multiplied abundantly, even large amounts of ammonia have no effect on oxidation.

In the soil where both organisms are abundantly present, nitrites never accumulate, as they are oxidized to nitrate as fast as they are formed. The nitrate formed in this way is the commonest form in which all crops (the legumes however only in part) obtain their nitrogen, and its preservation is therefore of very great importance in agriculture. It can, however, be lost to them in two ways. Firstly, by being washed into the subsoil by rain and thus carried beyond the range of their roots; and secondly, by being decomposed through the activity of certain bacteria, and having its nitrogen returned to the air as free gas, thus completing the nitrogen cycle. This latter process is called denitrification.

DENITRIFICATION.

This process can only occur where nitrates are accompanied by easily soluble non-nitrogenous organic matter, especially in an alkaline medium. It was formerly thought that air, i.e., free oxygen, must be absent, but this is now known to be an unnecessary condition. The freeing of nitrogen gas from the nitrates does not, however, always occur, but is often accompanied by reduction to nitrites and ammonia, an action exactly the reverse of the nitrifying one.

The writer found that if a sugar such as glucose is added to a purely mineral solution originally containing ammonia which has been completely nitrified to nitrates by the organisms conveyed in a little soil, an abundant bacterial growth forms, and in the course of twenty-four hours, at a temperature of 80-90° F., nitrites will be found in the liquid. After another day, ammonia will often be abundantly present, and the original nitrates will have completely disappeared.

In another case, after the preliminary formation of nitrites no ammonia can be found, but all the nitrogen will have disappeared from the solution ; in this latter case true denitrification has taken place, and the nitrogen has escaped into the air as the free gas. This has taken place where air had free access to the liquid, and was not the work of the nitrifying bacteria, which can only convert ammonia into nitrate, but of other organisms which were present in the soil originally inoculated, but which could only develop when the medium had been rendered suitable by the addition of the sugar.

Both true denitrification and the back action to ammonia are always preceded by a reduction of the nitrate to nitrite, and in fact very many bacteria can reduce nitrate to nitrite and can carry the action no further. One of the commonest soil bacteria (the so-called earth bacillus), *Bacillus mycoides*, which is very active in the breaking down of albuminous matter to ammonia during decay, is also able in the presence and absence of air, to reduce nitrates to nitrites and ammonia, so that an organism which is active at one stage of the nitrogen cycle can also be an effective worker at another stage. At the same time, as much as 20 to 30 per cent. of the nitrate nitrogen can be assimilated by the active organisms and converted into the albuminous matter of their bodies.

In some recent experiments made in Germany with soils heavily dunged with stall manure and receiving at the same time nitrate of soda, a large part of the nitrate nitrogen either disappeared as free gas or was taken up by the bacteria as body substance, and rendered non-available to the crop.

On the other hand, long-continued experiments at Rothamsted, England, in which both moderate quantities of dung and nitrate of soda were annually supplied to the same crop, have not made evident, by affecting the crop yield, that much loss has taken place through the above mentioned causes. Although denitrification can undoubtedly occur with free access of air, yet it is still more likely under conditions where air is excluded, or the supply greatly diminished. This can easily be shown by saturating a soil rich in organic matter with a solution of a nitrate ; after a few days no nitrates will be found in the water extracted from the soil.

In Japan, some recent observations have shown, that for rice grown in soils largely water-logged and richly dunged with faeces, sulphate of ammonia is a much more effectual manure than nitrate of soda, owing to partial denitrification of the latter.

On the other hand, some of the river waters of Jamaica which are known to be contaminated by sewage along part

of their course, very often show no trace of nitrates, although the water before contamination must have contained them. These streams flow along very shallow and rocky channels, and must be very effectually aerated, yet the soluble or organic matter brought in by the sewage has enabled bacteria to denitrify the nitrates originally present. The very low figures obtained for oxidizable organic matter in these waters go to support this conclusion, and show that in the self-purification of rivers in tropical climates, the organic matter and nitrates are mutually destructive under the influences of bacteria.

The circulation of nitrogen has now been followed along the main channel, through direct fixation of the free element, decay, and putrifaction, nitrification, and finally denitrification which completes the circle.

Almost no attention has, however, been given to two side channels which tap the main current at one point, only to return to it at another. One of these is that portion of green vegetation which obtains its nitrogen from the nitrates of the soil, builds them into the albuminous matter of its living structure, which, after death, is again returned to the soil to be again broken down by decay, and the successive bacterial processes of the main current.

Before, however, the return to the soil is made, a portion, both of this vegetation, and of the nitrogen-fixing legumes have to pass the animal body. This vegetable albumen is transformed to a small extent into animal albumen, but the greater portion, over 90 per cent., is almost immediately rejected again in a simplified form, in the case of the higher animals, by the urine. In man and the carnivorous mammals this is mainly as urea; among the herbivorous as hippuric acid; and by birds, reptiles, and fishes mainly as uric acid.

Urea is acted on very rapidly by many soil bacteria and converted completely into carbonate of ammonia; hippuric acid, though a more complex substance, is also broken down, at first into benzoic acid and glycocoll, and the latter again into carbonate of ammonia and water. Uric acid suffers the same fate through the instrumentality of soil bacteria, so that in all three cases the nitrogen excreted by animals finds its way back into the main current of the nitrogen cycle as ammonia, to undergo the further successive changes.

It is evident, then, that the total amount of animal life is determined by the amount of combined nitrogen available for nutrition. Under natural conditions there is no reason to believe that the total amount of combined nitrogen would tend to increase, i. e., that nitrogen fixation would be in excess of denitrification. On the other hand, with agriculture and its constant endeavour to increase crop production by creating conditions favourable to nitrogen fixation and unfavourable for denitrification, it appears most probable that the natural balance has been upset, and that the total of combined nitrogen in the world is probably on the increase.

Significant in this respect is the great extention of soil area during the last half century devoted to leguminous crops. It is, of course, impossible, as yet to estimate the extent to which nitrogen fixation is taking place through the energy of free living soil organisms, under agricultural conditions, and the same holds also for denitrification.

The few data to hand are for temperate conditions, the problem of the relation of soil organisms to crop production having, as yet, received no serious attention in the tropics.

MECHANICAL TILLAGE.

BY THE HON. FRANCIS WATTS, C.M.G., D.Sc., F.I.C., F.C.S.,

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During the last two years, a very considerable amount of attention has been directed in Antigua, to questions connected with the more extended use of implements in the cultivation of the soil; this has resulted in some important movements and experiments of some cost and magnitude.

Two firms have imported sets of steam-ploughing appliances from Messrs. Fowler & Co., of Leeds. Although the work was started, in each instance, by experienced ploughmen employed by Messrs. Fowler, some difficulties have been encountered owing to the peculiar conditions.

The advantages expected from steam ploughing are that deeper cultivation is possible, and consequently, the soil has a greater power of absorbing rainfall. Drought will, therefore, be the better able to be resisted, and the land able to be ploughed at the proper period, i.e., when in the best condition as regards moisture. The best cultural results may thereby be obtained, independent of the working animals of the plantation, which are busily engaged in crop time in hauling canes and in other duties, and so are not available for ploughing when, perhaps, it is most desirable that this work should be done.

One set of steam ploughs was introduced on the Belvidere estates. Here, owing to the peculiar character of the soil, coupled with an abnormally heavy fall of rain, the results obtained were far from satisfactory. Mr. A. St. G. Spooner, who has charge of these properties, has given the following notes on the work done:—

'Our land is for the most part a very heavy tenacious clay varying from brown to mouse colour, underlaid at a depth of from 8 to 18 inches by a yellowish clay subsoil of even greater tenacity and impermeability than the top soil. The lands are almost flat, so that great attention has to be paid to drainage.

Lands of this kind can really be only effectively broken up when the land is dry: (the condition between wet and dry most favourable to their working never exists but for a very short time under tropical conditions). If worked when wet the soil gets 'plastered' and runs together again, and no cultivation of any value can be done. When the soil is dry, it becomes so hard that no manageable team of oxen can plough it more than about 8 inches deep, and the work is very severe on the cattle. Twenty cattle and one plough average ½ acre ploughed per day.

'The land is divided by trenches about 18 to 20 inches deep into beds 15 to 25 feet wide, according to the heaviness of the land, and the cane rows run across these beds, the cane being planted in shallow furrows. The beds are made turtle-backed, so as to run the water from the cane furrows into the trenches in the case of rain falling at a greater rate than the land can absorb it.

'In ploughing with cattle, the land is ploughed along the beds and parallel with the trenches: so that the latter are not interfered with and only require a shallow re-trenching each time the fields are cultivated. If heavy rains fall when the land is being cultivated, the beds being turtle-backed and the trenches open, the water can run off, and so cattle ploughing can generally be done in the wet season after crop.

'With such shallow cultivation as is possible with cattle ploughs, the land suffers severely from drought in a dry season, and as the subsoil is unbroken, undrained, and sour, and consequently not permeated by cane roots to any extent; the root range of the cane is a small one, and the only way of getting good crops lies in the liberal application of pen manure to make the shallow feeding area of the crop as rich in available plant food as possible.

'In wet weather it is impossible to weed this sticky land, and much damage is done to the tilth by the running together of the soil, under the influence of the heavy tropical rains, so that almost as poor a crop is obtained in a wet year as in a very dry one. In order to obtain deeper cultivation with its consequent advantages of a greater power on the part of the soil to absord the rainfall and to resist drought, it was decided to introduce the use of steam-ploughing machinery, and a set of implements and engines were accordingly obtained from Messrs. Fowler, of Leeds, England, after our lands had been reported on by an expert from this firm. Other results of deeper cultivation would be the better drainage of the top soil, and the provision of a more extensive feeding area for the roots of the canes, thereby rendering the crop less dependent on pen manure, which it is almost impossible to produce in sufficient quantities, and the application of which, as well as the raising, is a matter of great expense. By the use of the more expeditious steam plough, too, it was hoped it would be possible to get through the whole of the cultivation in the dry months, when the oxen are employed in cane haulage. This would enable much earlier planting to be done (a most important point on heavy land, where growth is slow, in a not too hot climate like that of Antigua).

'Our experiences have not been fortunate, mainly because we have not had a sufficiently dry season, and also because the implements sent do not suit our conditions. It was not until August that the land was really dry enough for effective work, and then we found that the land could only be ploughed across the beds, and that when an attempt was made to plough along the beds, as with cattle ploughing, this could only be done as long as the plough wheels were both on the beds: as soon as one wheel was down in a trench the plough at once went so deep that the engines could not pull it, and it turned up large amounts of subsoil. It was, therefore, possible only to plough the middle of the beds, leaving half the land unploughed. Once the plough wheel got into the trench no amount of steering could get it out again with the implements Messrs. Fowler supplied, we had therefore no choice but to plough across the beds, and in doing this we of course ploughed across the trenches and filled them up. The work also had to be done very slowly for fear of breaking rope or plough. Thus, only about 4 acres a day could be done—about one-third of the amount of work that Messrs. Fowler's expert told us the ploughs would do. After these drains were filled up the land was subsoiled twice, at right angles, to a depth of about 2 feet. The land so broken up looked very satisfactory, but this state of affairs did not last long. Heavy rains fell almost immediately after, and there being no possible means for the water to escape, the land simply filled up with water, and became for some time a bog, over which walking was impossible. The water lay in pools all over the surface, and the effect of the elaborate cultivation was practically all lost. We started and reclaimed this land by digging trenches 50 feet apart and 3 feet deep through it, with clay spoons at a cost of nearly seven times that of re-trenching cattle-ploughed land. Even after this, it was some time before we could attempt any further operations, and by this time the land was a dense field of Para grass. After the costly elimination of this, the only thing to be done was to "bank" the land by manual labour, as the implement supplied by Messrs. Fowler was useless for its work even in the hands of the ploughman whom they sent out. In digging these trenches there was not the least evidence of the land having been twice subsoiled; it had simply set back to its original condition.

'Unless, therefore, land can be effectively drained down to the bottom of the subsoiling, say, 2 feet deep, immediately after the cultivation has been done, and before heavy rains fall, the whole value of the steam cultivation will be nil. The steam ploughman in charge of the plant seemed very doubtful whether any implement made by Messrs. Fowler could be made to take out trenches of this kind in such heavy land.

'Messrs. Fowler sent out an implement called a "mole drainer" to underdrain the land about 2-2½ feet deep. I shall say nothing of this implement, as we cannot claim to have tried it fairly. It is claimed that in a clay subsoil it will make a permanent drain and that open drains may be dispensed with. I have grave doubts whether it will prove of any use under our conditions. Steam ploughs have many things against them, and they are practically useless unless the land is very dry.

Under certain conditions, they will do excellent work; but if they are not to be a constant source of anxiety, they must be handled by expert, intelligent and highly paid men who have been used to them for many years. They are most difficult things to work, except in very dry weather, and the delays from breakages, when spares may have to be sent out from home, make it very risky to rely on them entirely. They will not plough land covered with fresh trash, but will plough this land after the trash has lain on it for about six months and become brittle and rotten. Until the difficulties of draining land subsoiled by them have been overcome, it is useless to subsoil, and if subsoiling is not done they have little or no advantage over ploughing by oxen, and are very much more expensive. Their right place would seem to be where large areas of land that do not require drainage have to be dealt with.'

Better results have been obtained with the other set of ploughs introduced on the estates of Messrs. Du Buisson & Co. Here the soil is lighter and better drained than at Belvidere, but even here difficulties were experienced. Those in charge of the appliances suggest that many modifications are desirable in order to enable the implements to do good work. I am not in a position to discuss these suggested modifications in detail. They lie, however, in the general direction of the use of broader tires on the wheels of several of the implements, in order to obviate the tendency to sink in soft soils; in the strengthening of several parts; the raising of the height of some of the frames; the modification of some of the stearing-gear, and many similar points, doubtless of significance. Although Messrs. Fowler sent expert ploughmen to start the work, and these men did a considerable amount of ploughing, still it may be suggested that some of the difficulties may arise from the inexperience of some of the other workmen employed. This, however, will not account for all the difficulties.

Under these circumstances, it seems possible that much time may be lost in correcting the difficulties owing to the fact that the makers and designers are at a distance from the places where the implements are used and are unable to form a correct appreciation of the problems involved. Much more rapid progress, and probably some considerable business developments, would appear to be possible if the makers of the appliances could see their way to send out a skilled representative who would spend his time in visiting the various West India colonies, and observing the machines in operation.

Despite these difficulties, which I have emphasized in the hope that it may be possible to remedy them, there is reason to believe that steam ploughing and cultivating will be successful, and will solve many of the problems at present met in the working of the sugar estates. Deeper and more thorough cultivation at those times when the soil is in the best condition for treatment, the breaking of the subsoil as well as improved surface tillage should do much to increase crops. In countries of deficient rainfall much benefit may be expected to result from such a breaking up of the subsoil as would

enable it to store up, and hold in reserve, that part of the rainfall which is not immediately required.

It has not been found possible to do satisfactory work with steam ploughs when the trash from the sugar-cane lies on the soil; this has therefore to be removed. Neither has it been found easy to apply pen manure in connexion with steam ploughing; it is difficult to turn in the pen manure in the process of ploughing; it is also difficult to get on the land in order to apply it after ploughing. An interchange of experiences of work in this connexion, would doubtless be profitable.

MECHANICAL TILLAGE OF CANES ON THE LOUISIANA PLAN.

A very important series of experiments on a large scale has been begun at Antigua by Messrs. Du Buisson & Co. Seeing that hand-labour is slow, expensive, and at times difficult to obtain, it was suggested that more efficient work might be done by introducing mechanical tillage on the plan followed in Louisiana; and consequently, a member of the firm visited Louisiana in order to see how the work is done, and to consult Dr. Stubbs with a view to introducing the methods into Antigua. Later on, one of the managers of the estates was sent to Louisiana to see the methods in operation, and to bring back with him a man skilled in the work, to superintend the experiments, and to bring such implements as Dr. Stubbs recommended, together with a supply of big mules suitable for hauling these tools.

Work has been begun on a fairly large scale, and I understand that some 60 acres of canes will be planted this season, on the Louisiana plan. This area is in several blocks situated in different districts.

Briefly, the system consists first, in flat-ploughing the land, for which purpose either steam or cattle ploughs may be used; then by means of mule ploughs, a bank is made much in the manner now commonly followed. The bank is repeatedly cultivated with a disc cultivator, and the furrows between the banks with a cultivator having 'shovels' or 'gangs.' These machines are drawn by a pair of mules, and the operator rides on the implements and guides the mules with reins. This work may be done early in the season, and crops of corn or peas may be grown on the ridges before the canes are planted.

The system of draining is important. In the system at present in vogue at Antigua, deep open drains are cut at short intervals at right angles to the banks and to the furrows of the ordinary cane cultivation; these open drains greatly interfere with the use of implements for tillage, and impede the work of carting out the canes in crop time. In the Louisiana system, on moderately heavy soil,* drains about 18 inches deep, 2 feet wide at the bottom, and $2\frac{1}{2}$ feet at the top, are dug *parallel*

*The distances between the drains and quarter drains may be varied according to situations and the character of the soil.

with the ridges at every fifteenth ridge (75 feet). The practice has been adopted of growing grass on the sloping sides of these drains in order to hold the soil in place. Shallow trenches known as 'quarter drains' are opened at right angles to these, and so at right angles to the banks, at distances of from 60 to 80 feet. These quarter drains are 2 feet wide and, in the first instance, about 2 inches deep. As work progresses these drains are slowly deepened, so that by the time the weeding of the cane crop is finished, they have been deepened to about 6 inches. These drains are cleaned out by means of a hand shovel after every cultivation.

Fears were entertained that this system of draining might prove inadequate on heavy soils in conjunction with heavy tropical rain, but it is interesting to note that since this work has been in progress, Antigua has been visited with one of the heaviest deluges on record, the rainfall for the month of September having been from 18 to 22 inches (the average annual rainfall at Antigua is 45 inches), and I am informed that this system of draining appeared to fulfil its functions admirably, even under the severe strain mentioned.

In order that the cultivators may work, the canes are planted on the ridges, and not in the furrow as is now the common practice; and, further, the system of continuous planting is being tried, i.e., the cane tops or cuttings are placed in a continuous row, each piece almost touching the other. The experiments are being watched with the greatest interest, and there is a good deal of speculation as to the chance of success of canes so planted.

Some minor difficulties present themselves: one is that the ploughs and cultivators cannot work through the trash if it is left on the ground. Dr. Stubbs unhesitatingly recommends that it be burned, but I am reluctant to encourage this, and recommend that it be removed and used for the making of pen manure. It would seem possible to erect field pens (hurdle pens) at convenient distances in and about the fields, and so encourage the making of quantities of pen manure and compost far in excess of the amounts now obtained. This side of the question received some attention when the manuring of sugar-canes was under discussion.

Some difficulty also lies in the fact that it is not easy to apply the necessary pen manure to the land; if the manure is at all long or coarse, and is spread broadcast over the surface, it fouls the ploughs and impedes their work. On the other hand, it is troublesome and expensive so to place the manure that it may be covered in making the ridges. I understand that experiments are to be made in the direction of obtaining short, well-rotted manure, if necessary by cutting up the trash and other material before putting it in the pens, and spreading the manure on the fields by means of mechanical manure distributors.

It is recognized that these efforts are purely experimental and that the plans now in operation may require to be profoundly modified in order to obtain methods well suited to

local requirements. It will, I think, be generally recognized that these are efforts in the right direction, and calculated to promote advancement and increased efficiency. Planters will therefore recognize, that they are indebted to the enterprising firm that is now conducting experiments for many valuable lessons.

It may be urged that developments along these lines are likely to lead to agricultural elevation; labour is calculated to be made more productive and efficient. If this is so, it must follow that it will become more skilled and better remunerated. If some labour is displaced, it will be that of an unskilled and poorly paid type, which may find better and more profitable employment in other directions. The increased production of sugar-cane, which may be looked for with the introduction of improved machinery, and the phenomenal growth of the cotton industry demand the employment of more and more labour; indeed, it is suggested that the further development of the agricultural resources of Antigua may be limited by a shortness of the labour supply. Under these circumstances, the introduction of improved machinery, whether in the direction of manufactures or of field operations, is calculated to improve the position of wage-earners and elevate the labouring classes.

These experiments, conducted in so thorough a manner and on so liberal a scale, appear to me to be worthy of the attention of a Conference of the present nature. It is too early yet even to indicate the chances of success, but it is hoped the experiments may furnish interesting material and a history of some successes for discussion at a future Conference.

SELECTIVE CANE REAPING AT JAMAICA.

BY MR. A. CHARLEY, Jamaica.

The method of reaping or cutting canes that is usually adopted throughout the West India Islands involves the cutting of the whole field clean to about the level of the ground. Unripe canes are cut with those that are fully ripe, and all young suckers, many of which are of no value to the factory for sugar manufacture, are cut down to the ground. Canes that are, therefore, ratooned have to make an entirely new growth, whereas it is possible to save much plant growth in a field of canes when it is cut, by allowing the young suckers to remain untouched by the cutlass. These would continue to grow, or, at least, would hold their own throughout the dry season, and furnish a good start for the ratoon crop. An entirely fresh growth of suckers would not have to be depended upon.

The method of selective cane reaping, as started by Mr. T. Campbell and myself in the year 1875, has resulted in the establishment of a system that is generally known as 'picking' canes. This system is largely practised in the parish of Westmoreland, Jamaica, and has given very good results. It is here briefly described in the hope that it may be of value to other growers of sugar-cane, especially in those districts where ratooning is generally practised.

All full-grown, rpie canes are carefully selected and cut very low down at the roots; especial care being taken not to injure the unripe suckers, as it is by these that the life of the field is sustained during the long dry months of the crop. The full-grown, ripe canes that have been cut out are then divided into pieces of about 4 feet in length and these portions tied up into bundles. Ten lengths of cane make one bundle, and fourteen bundles are thrown together into a heap. The heaps are made by the cutters in intervals through the field, where carts can gather them up and take them to the mill. The labourer is paid at various rates for cutting the canes and making these heaps. In Westmoreland, 1*s*. is paid for every twelve heaps, while in Hanover the labourers receive a wage at the rate of 1*s*. for every fourteen heaps.

The labourers also carry all cane tops to the intervals in which the heaps of cane are made, so that they may be conveniently carted away for use in planting or for fodder for the cattle. No carts are allowed to run on the fields, other than in the intervals, and no cattle permitted to graze or trample over the suckers that are left standing.

It has been found that by adopting this picking of only full-grown, ripe canes, the roots appear to become stronger and to grow deeper in the soil, with the result that the suckers that have been left, develop better and give heavier crops of canes than can be obtained from ratoons on fields that have been cut clean. By adopting careful 'picking,' ratoons may profitably be grown for a period of from three to five years,

and the expense of planting large areas every year in plant canes is, thereby, avoided.

It may be possible that Westmoreland planters by adopting such a system, together with a judicious use of artificial manures, might obtain very profitable returns from ratoons.

Fields that undergo inundation from river water and in which picking is practised have ratooned well for thirty years. Naseberry piece on Masemure estate which is subject to inundation from the Canaan River was planted in 1865. It now yields 1 ton of sugar per acre, and this yield is estimated to be more profitable than would be expected from yearly renewal with plant canes, that would give about 2 tons of sugar per acre.

On my estate Kew, in Hanover, that is subject to inundation from the Georgia River, it cannot be ascertained when 150 acres of canes were planted. The oldest inhabitants do not remember this area being planted, but it has been found that ratooning after 'picking' has given good results.

As an experiment, at the request of one of my overseers, several fields of canes were cut clean, and all canes removed from them by carts, and cattle were allowed to graze over them in a similar manner to that now practised in the Vere district of Jamaica.

The results showed that the fields that were cut clean gave but light crops as ratoons, and it took them fully three years to come up to the standard of the remainder of the estate where 'picking' or 'selective cane reaping' had been practised, thus showing that the system briefly described above is worthy of careful consideration at the hands of sugar growers.

THE POLARIMETRIC DETERMINATION OF SUCROSE.

BY THE HON. FRANCIS WATTS, C.M.G., D.Sc., F.I.C., F.C.S., AND

H. A. TEMPANY, B.Sc., F.I.C., F.C.S.

PART III. (THE CLERGET METHOD.)

The following paper is issued as a continuation of the work in this connexion carried on in the Government Laboratory for the Leeward Islands. H. A. Tempany is in the main responsible for the details following herein.

The Clerget method of inversion has for many years been recognized as the standard method for the accurate determination of the sucrose content of sugars and sugar-house products.

At the present day, the necessity for more uniform and accurate methods of sugar analysis is widely felt, and on every hand the more general employment of the Clerget method in sugar-house work is advocated.

Though it is impossible, under existing conditions, that the Clerget method should find general employment in the ordinary analytical routine of factory control, in place of the simple direct measurement of the optical rotating power of the various substances handled, yet there can be no doubt that for all accurate work, the Clerget method is the best to employ.

Various other processes for the determination of sucrose by inversion have been proposed, e.g., the use of invertase, or the method of Lindet; but none of these can as yet claim to have attained to a similar position to that occupied by the Clerget method.

The process as originally devised by Clerget was presented by him to the Society of Encouragement of National Industry on October 14, 1846. The following description of the original method is taken from Wiley's *Principles and Practice of Agricultural Analysis*:—*

'The basis of the law rests upon the observation that a solution of pure sugar, polarizing 100° on the sugar scale, before inversion, will polarize 44° to the left after inversion at a temperature of zero. The quantity of sugar operated upon by Clerget amounted to 16·471 grammes in 100 c.c. of liquid. On the instrument employed by him this quantity of sugar in 100 c.c. gave a reading of 100° to the right on the sugar scale when contained in a tube 20 centimeters in length. The process of inversion carried on by Clerget is as follows·—

"The sugar solution is placed in a flask, marked on the neck at 100 and 110 c.c.; or if smaller quantities are used, in a flask marked on the neck at 50 and 55 c.c. The flask is filled with the sugar solution to the first mark, and then a sufficient quantity

* Vol. III, 1897 edition, pp. 106-7.

of strong hydrochloric acid added to bring the volume of the liquid to the second mark. The mouth of the flask is then closed with the thumb and its contents are thoroughly mixed by shaking. A thermometer is placed in the flask which is set in a water-bath in such a way that the water comes just above the level of the liquid in the neck of the flask. The water is heated in such a manner as to bring the temperature of the contents of the flask, as determined by the thermometer, exactly to 68°, and at such a rate as to require fifteen minutes to reach this result. At the end of fifteen minutes, the temperature having reached 68°, the flask is removed and placed at once in another water-bath at the temperature of the room, to which temperature the contents of the flask are cooled as rapidly as possible. To make the polarimetric observation, a tube 22 cm. in length is filled with the inverted sugar solution by means of a tubulure in its centre, which serves not only the purpose of filling the tube but afterwards of carrying the thermometer, by means of which the temperature of observation can be taken. If the sugar solution be turbid, or contain any lead chloride, due to the previous use of basic lead acetate in clarification, it should be filtered before being introduced into the observation tube. The tube, being one-tenth longer than the original, compensates for the dilution caused by the addition of the hydrochloric acid in inversion.

"When reading, the bulb of the thermometer should be withdrawn far enough to permit the free passage of the ray of light, and the exact temperature of the solution noted."

It must be borne in mind that the successful application of the Clerget method depends on the rigid observance of the conditions for which the factor was determined. In the original method of Clerget only a little over 16 grammes of sugar are employed for 10 c.c. of concentrated hydrochloric acid.

In Germany, it was customary for many years to employ the Ventzke normal weight of 26·048 grammes in 100 c.c. Mohr, with 10 c.c. of hydrochloric acid, and to use Clerget's original factor.

Various modifications of the process have from time to time been advocated, but the one that has gained general acceptance is that of Herzfeld.*

This method is at the present time the standard one in Germany, and has been advocated for general adoption by the International Commission for uniform methods of sugar analysis.

In this process 13·024 grammes of sugar are dissolved in 70-75 c.c. of water, 5 c.c. hydrochloric acid are added, and the mixture is brought up to 68° C. in the course of five minutes, the solution maintained at that temperature for another five minutes then cooled down, made up to 100 c.c. at 20° C., and

* *Zeitschrift des Vereins fur Ruben Zucker Industrie*, 1888, p. 707.

polarized in a 200-mm. tube. Herzfeld worked at a standard temperature of 20° C., and at this temperature and under the above conditions he arrived at the formula $S = \frac{2D}{132{\cdot}66 - \frac{t}{2}}$ for the sucrose content of the sample under examination where S is written for sucrose content, D for difference between the polarization before and after inversion, and t for the difference between the temperature of the observation and 20° C.

This result is very similar to that arrived at by Landolt earlier in the same year and the entire subject was re-investigated and reviewed by Börntrager in 1901.*

Börntrager, after a large and comprehensive series of experiments, confirmed Clerget's original factor for the conditions formulated by him, and also checked Herzfeld's results. He arrived at the concluison that the best method to employ was that of Herzfeld.

In face of this and of the pronouncement of the International Commission, it would tend to appear that any further modification was unnecessary.

At the same time, it must be borne in mind that the method of Herzfeld has not yet received general acceptance except in Germany. Frequently, the fact that the factor to be employed depends entirely on the conditions of the experiment, is not duly recognized, and this point was brought home to the writers very forcibly some time ago, in connexion with an inquiry into the possible occurrence in cane juice, of some dextro-rotatory substance other than sucrose, which necessitated the performance of a considerable number of Clerget inversions.

In addition, it has always appeared probable that a fundamental objection to the method of Herzfeld has been that it necessitates the doubling of the polarimeter reading, and consequently of the experimental error.

Furthermore, the method is of great importance in cane-producing countries, where the usual temperature is about 30° C., and this, coupled with the somewhat uncertain nature of our present knowledge of the variation of the specific rotation ot acid solutions of invert sugar with temperature, gives sufficient warrant for further investigation of the problem.

In attacking the problem, it was thought that it might be of interest if the inversion were performed with more dilute solutions of hydrochloric acid, it being held that if this were done, it should give more latitude in the performance of the determination, as far as the duration of heating was concerned.

Under the conditions of both the original Clerget method and that of Herzfeld, the concentration of hydrochloric acid

* *Zeitschrift des ver der Deut. Zucker Industrie*, 1901.

is relatively high, and if the heating is prolonged beyond fifteen minutes, reversion sets in, owing to decomposition of levulose. This results in the formation of substances either optically inactive, or with opticity differing considerably from that of levulose. Thus the determination is vitiated.

The method finally adopted was to work on a normal sugar solution, and to perform the inversion on either 50 or 100 c.c.; using a 50-55 or 100-110 double-marked sugar flask. The amount of hydrochloric acid used was in the proportion of 2 c.c. fuming hydrochloric acid to 100 c.c. of normal sugar solution.

EXPERIMENTS.

Sugars employed.—A number of high-grade refined cane sugars were employed in these experiments, including a specimen of pure sucrose from Kahlbaum. Before use, the sugars were dried in a desiccator, at air temperature, for twenty-four to forty-eight hours.

The flasks used were standardized by the National Physical Laboratory.

Polarimeter.—The polarimeter was a triple field instrument by Schmidt and Haënsch, standardized for 17·5° C. Before performing the experiments, it was checked by means of a set of quartz plates standardized by the Reichsanstalt Charlottenburg, and also by Professor H. W. Wiley, of the Bureau of Chemistry, U.S. Department of Agriculture, Washington. The results of the standardization are given below.

Polarimeter lamp.—The lamp was a double-wick polarimeter lamp for kerosene, and in order to minimise variations of temperature during the taking of the readings, it was enclosed in a wooden case, a hole being cut in the case opposite the lens. Between the lens of the polarimeter lamp and the polarimeter, a piece of sheet glass was inserted in order to lessen still further the effect of direct radiation on the polarimeter.

Polarimeter tubes.—The polarimeter tubes were jacketed, and a current of water at 30 C. was kept slowly flowing through the jacket during the taking of the readings, for by this means, it was found possible readily to keep the temperature of the solutions constant within $\frac{1}{10}$th. of a degree Centigrade. The experiments were all performed at a standard temperature of 30° C. The solutions were made up and polarized at that temperature.

Experimental details and results.—In performing the experiments, 25·988 grammes of sugar* were weighed out, dissolved in distilled water and made up to 100 true c.c. at 30° C.; the standard temperature being attained by means of immersing the solution in a water-bath maintained at that temperature till the solution had reached the temperature of the bath, and then making up to the mark. This solution was polarized, as

A solution of 25·988 grammes sucrose in 100 true c.c. is of the same concentration as 26·048 grammes in 100 Mohr c.c.

stated above, in a 200-mm. jacketed polarimeter tube. round which a stream of water at 30° C. was kept flowing; 50 c.c. of the solution were then measured out into a 50-55 c.c. flask at 30° C.; 1 c.c. fuming hydrochloric acid was added, a thermometer and a platinum stirrer were inserted in the liquid, and the whole was thoroughly mixed by means of the stirrer.

The solution was then placed in a bath containing hot water, and in the course of five minutes raised to a temperature of 68° C When it had attained that temperature, it was maintained steadily at it for a length of time, varying in individual experiments, of fifteen or twenty minutes. During the whole of the heating, the liquid was kept constantly stirred by means of the platinum stirrer, it being found that in this manner it was easily possible to avoid all variations of internal composition of the liquid due to imperfect mixing of the acid and sugar solution.

When the heating was complete, the inverted solution was cooled down to 30° C., the thermometer and stirrer were washed into the solution with water at 30° C. The solution was then made up to 55 c.c. at 30° C., and polarized in a 220-mm. polarimeter tube jacketed with water at 30° C.

In the results that follow, each polarimeter reading recorded is the average of twelve or more readings by two observers:—

Standardization of Polarimeter.

Zero, mean of twenty readings	+ ·025° V.
Quartz plate true value	+ 96·93° V.
Polarimeter reading of quartz plate, mean of twenty readings	+ 97·025° V.
Polarimeter too high	+ ·095° V.

Quartz plate true value . ..	− 10·185° V.
Polarimeter reading of quartz plate ...	− 10·142° V.
Polarimeter too low	+ ·043° V.

To each of the average readings a correction is added for: –

(a) expansion of the polarimeter tubes from 17·5°C., the standard temperature. and 30°C., at which the readings were taken. This is given by $C = (\cdot0000086\,t)\,N$, where C is the correction, t the difference between the observed temperature and 17·5°C., (in this case 12·5°C.), and N the polarimeter reading.

(b) for the influence of temperature on the quartz wedge of the saccharimeter, viz:—$\text{Pol.} = (1 + \cdot0014\,t)\,N.$, (Jobin's formula).

(c) in the case of the direct reading, for the influence of temperature* on the specific rotation of sucrose, viz:—$\text{Pol.} = (1 + \cdot0017\,t)\,N.$

As already stated, the following series of readings is each the mean of twelve readings by two observers.

As a mean of the ten series of results, we arrive at the value 128·08 for the factor at 30°C., and for the conditions mentioned above.

* See Watts and Tempany. The Polarimetric Determination of Sucrose, Part II, *West Indian Bulletin*, Vol. VII, pp. 132-40.

TABLE I.

No. of Experiment.	Mean of twelve direct polarimeter readings.	Correction for instrument.	Correction for effect of temperature on sucrose and quartz wedge	Correction for expansion of tube.	Corrected direct reading.	Polarimeter reading after inversion.	Correction for instrument.	Correction for effect of temperature on quartz wedge.	Correction for expansion of tube.	Corrected inverted reading.	Factor for pure sucrose at 30 C.	Time occupied in heating.
1	+99·579	-·095	+·387	-·011	+99·860	-28·012	-·043	-·049	+·003	-28 101	128·14	5 mins. heating to 68° C.; 20 mins. at 68° C.
2	+99·629	- 095	+·387	011	+99·910	-28·088	-·043	-·049	+·003	-28·176	128·20	„ „ „
3	+99·354	- 095	+·385	-·011	+99·633	-27·759	- 043	-·049	+·003	-27·848	127 95	„ „ „
4	+99·459	-·095	+·386	-·011	+99·739	-27·912	-·043	-·049	+·003	-28·001	128·07	„ „ „
5	+99·554	- 095	+·387	-·011	+99·835	-27 962	-·043	-·049	+ 003	-28 051	128·10	„ „ „
6	+99·589	-·095	+·387	-·011	+99·870	-27 866	-·043	-·049	+·003	-27 957	128·00	„ „ „
7	+99 612	-·095	+·387	-·011	+99·893	-27·970	-·043	-·049	+·003	-28 059	128 08	„ „ „
8	+99·583	-·095	+·387	-·011	+99·864	-28·062	- 043	- 049	+ 003	-28·159	128·20	5 mins. heating to 68° C.; 15 mins. at 68° C.
9	+99·658	-·095	+·388	-·011	+99 940	-27 946	-·043	-·049	+·003	-28·035	128·05	„ „ „
10	+99·597	-·095	+·387	-·011	+99·878	-27 939	-·043	-·049	+ 003	-28·028	128·06	5 mins. heating to 68° C.; 25 mins. at 68° C.

Consideration of results obtained.—It will be seen from the above results, that the use of more dilute acid gives considerably more latitude as regards the time during which the heating is continued. In the above results, the time during which the solution was maintained at 68°C., varied, as will be seen, from fifteen to twenty-five minutes without materially affecting the value arrived at. To investigate still further .the range of time during which it is possible to maintain the temperature at 68°C., two more series of experiments were performed, in one of which the temperature was maintained at 68°C. for ten minutes, and in the other for thirty minutes. In both cases the process of heating up occupied five minutes as usual.

The following are the results obtained :—

	Corrected direct reading.	Corrected inverted reading.	Value for 100°V.	Factor value.
a. 5 minutes heating up. 10 minutes at 68°C.	99·914	-27·876	-27·90	127·90
b. 5 minutes heating up. 30 minutes at 68°C.	99·528	-27·776	-27·91	127·91

From these two results, it appears that the reaction is practically complete under the above condition in fifteen minutes starting from the cold, and that prolonging the heating till thirty-five minutes have elapsed from the time that the heating was commenced has little or no effect on the determination.

It may be pointed out that prolonging the heating to thirty minutes, under the conditions of the original method of Clerget or as Herzfeld's modification, causes reversion to set in to a marked extent.

In order to obtain a check on the above results and also a direct comparison with those of Herzfeld, and to endeavour to ascertain how far Herzfeld's factor applied to the higher temperature. 30°C., an experiment was performed working with the same apparatus and at the same temperature as above, 30 C., but using Herzfeld's method as laid down by him.

In the experiment a normal weight of sugar was dissolved in distilled water made up to 100 c.c., and polarized at that temperature ; 50 c.c. of this solution were then measured into a 100 c.c. flask, and 5 c.c. of hydrochloric acid, and 20 c.c. of distilled water added. The flask and contents were then brought up to 68° C. in the ourse of five minutes, and maintained at that temperature for another five minutes, then cooled down to 30° C. once more, and the solution made up to 100 c.c. and polarized in a 200-mm. glass tube.

The following results were obtained :—

Mean direct reading	=	99·462
Correction for instrument and tube	=	- 0·106
Correction for effect of temperature Sucrose and quartz wedge ...	=	+ 0·386
Corrected direct reading ...	=	99·742
Mean inverted reading	=	- 13·751
Correction for instrument ...	=	- 0·043
Jobin's correction for quartz wedge	=	- 0·024
Correction for tube	=	+ 0·002
Corrected inverted reading ...	=	- 13·632
Corrected inverted reading 2 ...	=	- 27·632

Whence, factor for pure sucrose = 127·70.

The factor arrived at by Herzfeld for a standard temperature of 20° C., is 132·66, and if this is calculated for 30° C., on the usual assumption that every 2° C. increase in temperature above the standard lowers the factor 1° V., we get, for the factor at 30° C., 127·66 —a result so close to that recorded above as to be in almost absolute ageeement with it.

In order to effect a further comparison of the two methods and also to investigate the practical utility of the method detailed above, a determination of cane sugar in a sample of raw sugar was performed by both methods.

Two hundred cubic centimeters of a normal solution of muscovado sugar were prepared and clarified by means of basic lead acetate using Horne's dry defecation method. The clarified solution was polarized direct at 30°C. Two portions of 50 c.c. each of the solution were then taken, one was placed in a 50-55 c.c. flask, 1 c.c. concentrated hydrochloric acid added, and the solution brought up to 68°C. in the course of five minutes, maintained at that temperature for fifteen minutes, then cooled down and made up in the usual way ; the other was placed in a 100 c.c. flask, 5 c.c. hydrochloric acid and 20 c.c. of water were added, the solution was brought up to 68°C. and maintained at that temperature for five minutes, then cooled down and made up. The solutions were made up to 55 c.c. and 100 c.c. at 30°C., and polarized in 220 and 200 mm. jacketed tubes, respectively.

The results were as follows :—

Mean direct polarization ... ... 88·05 V.

Mean inverted polarization (Herzfeld's method)	- 12·3	Mean inverted polarization as above ...	- 24·97
„ „ (2)	- 24·6		
Factor	127·66	Factor	128·08
Sucrose content per cent., according to Herzfeld	88·25	Sucrose content per cent.	88·25

From this it will be seen that with careful working both methods give identical results, and there can be no doubt that

by rigid adherence to the conditions laid down and careful measurement, a very high degree of accuracy is obtainable by either method.

SUMMARY OF RESULTS.

For the method given above the following advantages are claimed :—

1. The use of lower concentrations of hydrochloric acid admit of greater variation in the time of heating.

2. The making up of the solution after inversion to 55 c.c. and polarizing in a 220-mm. tube does away with the necessity of doubling the reading and thereby the experimental error.

3. The making up of the solution to bulk after heating does away with the risk of vitiation of the results owing to concentration by evaporation, which must occur in Clerget's original method in which the solution is made up to either 55 or 110 c.c. before heating.

The above results emphasize the very great accuracy of the process as an analytical method, and the indiscriminate use of factors regardless of the conditions for which they were determined cannot be too strongly deprecated, as detracting from the intrinsic accuracy of what is undoubtedly one of the most accurate processes employed in organic analysis.

Thanks are due to Mr. R. H. Malone for much valuable assistance rendered during the carrying out of the experiments.

JAMAICA RUM.

BY THE HON. H. H. COUSINS, M.A., F.C.S.,

Government Analytical and Agricultural Chemist, Jamaica.

To deal with this matter in a manner adequate to its importance, and up to the standard of thoroughness to which the members of this Conference are accustomed in the treatment of the subjects brought before them, would involve a communication of such length as to be beyond all reasonable limits on this present occasion. Subject to Sir Daniel Morris' approval, I have in preparation another paper, for publication in the *West Indian Bulletin*, in which the general subject of rum is more fully dealt with, and a summary of the outcome of the investigations that have been made upon it by the officers of the Sugar Experiment Station in Jamaica, together with a report prepared by the late Fermentation Chemist, Mr. C. Allan, B.Sc., of his observations during his three years' study of the micro-organisms of rum, are presented.

I now propose with your kind indulgence to attempt a brief description of the miscellaneous types of sugar-cane spirit included under the generic name 'Jamaica rum,' and to illustrate this by submitting a series of typical samples for your examination.

As in all special industries, we have our trade secrets in the manufacture of Jamaica rum, and it is notorious that the rum trade is one of the most jealous and unapproachable of business interests.

It would not be fair, therefore, to attempt to disclose before such a gathering as this, any special secrets which it has been our lot to discover in the course of the investigations into the problems of rum manufacture, that have been made in Jamaica during the past three years. At the same time, I do not fear the competition of the other sugar-producing colonies with Jamaica in the manufacture of rum, and I am satisfied that the planters in this island have everything to gain, and very little to risk, by the fullest possible inquiry into all branches of the rum industry. Jamaica rum is, to a large extent, the natural outcome of local conditions that are apparently unique, and it is not to be expected that the laborious and slow minutiae of a high-flavoured rum process could ever form part of the industrial working of a large sugar factory in Cuba or in British Guiana.

CLASSES OF JAMAICA RUM.

To understand the wide differences in the quality of Jamaica rum, we must first recognize that there are three

distinct classes of rum produced in the island, each adapted for a particular market, and each judged by a different standard of excellence.

To answer the question—'What is a good Jamaica rum?' involves a second inquiry: 'To what class of Jamaica rum do you refer?' The three classes are as follows:—

(1) Rums for home consumption, or 'local trade quality.'

(2) Rums for consumption in the United Kingdom, or 'home trade quality.'

(3) Rums for consumption on the continent, or 'export trade quality.'

Each of these grades of rum meets the requirements of a special market, and is judged by a different standard of quality. I would particularly urge that these three markets, being self-contained, do not compete one with the other, and that the idea that the producers of export quality are thereby prejudicing the sales and commercial success of the 'home trade' qualities is entirely without foundation.

So far as I have been able to arrive at the facts, the commercial spheres of the three classes of rums are entirely distinct, and there is no reason to believe that the production of high-flavoured rums for blending on the continent is in any way prejudicial to the interests of the home trade Jamaica rums consumed in the United Kingdom.

Each class of rum is entirely legitimate, and there is no reason whatsoever why the makers of different types of Jamaica rum should be jealous one of the other. Again, any competition between individual estates is also without reasonable basis. Unless an article is producible in adequate quantity, and with sufficient variety of quality to enable the variable tastes of consumers to be catered for, no satisfactory trade can be developed.

With regard to the export qualities, I have received the most convincing assurance that the danger of the future of this trade lies not in over- but in under-production.

CLASS I. LOCAL TRADE QUALITY.

The most sensitive barometer of the material prosperity of the population of Jamaica is to be found in the Collector-General's returns of the rum duties.

Those of you who visited Port Antonio on Saturday might have observed mural notices to the effect that 'rum ruins'—a statement which is not open to question when the rum consumed and the cubic capacity of the consumer are to any large extent in an inverse ratio, and in favour of the liquor.

When we consider, however, that the local consumption of rum does not exceed three or four bottles per head per annum,

the Jamaican cannot be charged with ruining himself with rum to any great extent.

From the point of view of the revenue and the administration of government, it is only to be regretted that our people are unable to afford the luxury of consuming three or four times as much rum as they do at present, so that a marked reduction in taxation could be effected. While rum remains the wine of the country, so far as the lower orders in Jamaica are concerned, nothing is so striking to an observer of the habits of the upper classes, as the very large extent to which imported Scotch whisky (some of it very recent, very fiery and of very patent-still quality) has displaced rum. The high-class trade in old rums of delicate softened flavour, which were formerly so highly thought of by the planters and moneyed classes, has largely disappeared, and it would probably be most difficult to obtain a choice mark of an old rum, which has not been blended, from any spirit merchant in Jamaica to-day. Blends are the order of the day, and the public house trade is the chief field in which the local quality of rum is employed.

For this purpose a light rum that will age or mature very rapidly is a great desideratum. These rums are mainly produced in Vere and St. Catherine, and are the result of light settings and a quick fermentation. The stills are heated with steam coils, and double retorts are used.

The ether content of these rums varies from a minimum of 90 parts per 100,000 volumes of alcohol to about 300 parts. The bulk of this spirit would average from 180 to 220 parts of ethers. It will be noticed from the samples submitted for inspection that these rums have a delicate pleasant aroma, and when broken down with water yield a light type of residual flavour which is markedly inferior to that of the rums in Class II.

The basis of flavour of these rums is principally due to acetic ether, while the characteristic flavour and aroma of each estate's mark, appear to be due in every case to traces of the ethers of the higher acids, and, in a less degree, to traces of caprylic alcohol and other higher alcohols of an aromatic nature.

CLASS II. HOME TRADE QUALITIES.

These are sometimes alluded to as 'public house rums' and represent the class of spirit which is required for the use of the spirit trade in the United Kingdom as 'Jamaica rum.' Owing to the strenuous efforts of Mr. Nolan, the protector of Jamaica rum in the United Kingdom, much interest has recently been shown by the retailers and consumers at home in genuine 'Jamaica rum.' The rums of the class to which I now refer, and which constitute the bulk of the rum exported from Jamaica, represent the type of spirit which Mr. Nolan is seeking to advertise, and to protect from fraudulent adulteration, and from the competition of spurious Jamaica rum in the United Kingdom.

It was at one time considered that an analytical standard of ethers could be fixed whereby a genuine Jamaica rum could

be differentiated from a patent-still colonial rum or a blended Jamaica rum. While, however, the best types of 'home trade rums' contain 300 to 500 parts of ethers, and the great bulk of the rum exported from Jamaica is well above a standard of 200 parts of ethers, there are certain marks of rum (and among them some of stout body and attractive quality) which are as low as 100 parts of ethers. Except in cases of gross adulteration, therefore, purely analytical evidence is not of much avail in deciding whether a rum be a genuine Jamaica rum or not. A proposal to prohibit the exportation of any rums below a standard of 200 parts of ethers was seriously considered by the planters last year, but was thought to be unfair to individual estates, and eventually was abandoned.

The formation of a Jamaica rum syndicate whereby a monopoly of this article is sought by a corporation to enable a higher price to be obtained has recently been effected. If the syndicate can carry through its undertakings, an increased price to the retailer of 1*d.* per bottle of genuine Jamaica rum would suffice to secure the planters an additional 6*d.* per gallon for their rum, and provide a fund of £30,000 a year for advertising the merits of 'Jamaica rum.'

I estimate that a capital of £500,000 is required to ensure the full operation of this scheme. It must be remembered that if a puncheon of rum be sold for £10, the British revenue charges amount to £75, and the corporation will require a capital of £85 before the puncheon of rum can be dealt with as a commercial article. A large trading capital to allow of credits to publicans and other customers would be necessary. If this enterprise could be floated by interesting a large number of retailers in the shares of the company, as was done by the Guinness flotation, it is reasonably certain that a great success could be achieved.

The best rums for the home trade are made in Westmoreland, while some very fine rums are also produced in Clarendon, St. James, and Trelawney, which fall in this category.

These rums are generally produced by a slower type of fermentation than the local trade rums, and some of the best marks are produced in ground cisterns, and are slightly flavoured by the addition of some sour skimmings to the fermented materials. These rums are characterized by a high standard of heavy residual body. These are mainly ethers of acids of high molecular weight. These acids are not producible from sugars, and are almost absent in rums other than Jamaican, which are produced from diluted molasses without dunder or acid skimmings, and distilled in patent stills. Our investigations indicate that these higher acids result from the bacterial decomposition of the dead yeasts found in our distillery materials in Jamaica, and I am forced to the conclusion that the adherent yeasts in the old ground cisterns have a good deal to do with the fine flavour of many of these home trade rums.

When in London recently in the office of the leading broker who handles Jamaica rum, I was shown samples of the chief marks of home trade rums which were considered to set the

standard of quality. 'We do not want ethers, but a round rummy spirit,' said this broker. I was pleased to find, however, that the marks selected as standards were all of high ether content (from 300 to 450 parts of ethers). They had, however, a very good standard of heavy residual body, and the blend of flavours was both mellow and full.

A trade expert in Jamaica, from whom I have obtained help on various occasions, writes me: 'The earmarking of rum is to my idea a mistake, as any one with the least elementary knowledge of spirits knows that a blend is better than a naked spirit, always provided the blender knows his business.'

So far as the rum syndicate is concerned, there is no reason whatever why our Jamaica rums should not be blended one with another in order to get a round, full, and attractive blend; and it is to be presumed that this would be necessary in the development of the bottling trade.

The samples of home trade rums submitted have been selected from a large number as representative of this class of Jamaica rum. As compared with the local trade rums, it will be noted that they have a stouter, fuller, and more fruity aroma, and that when broken down with water, the spicy residual flavour is strongly marked.

It was impressed upon me in London by the trade experts that the planters in Jamaica should recollect that, as the duty payable on rum in England was about eight times that of its value to the planter, it was a most serious matter for the buyers at home if any fault should be found with the rum after it had been cleared from bond. Points that required attention were: (a) cloudiness on dilution; (b) a burnt flavour; (c) excessive obscuration.

We have found the chief cause of cloudiness in Jamaica rums to be due to high settings, and such an intensity of bacterial action that higher alcohols are produced in excess. The charge of wines in the retort being inadequate to fractionate these impurities, they enter into the rum and cause cloudiness on dilution. To remedy this fault, insist on the distiller testing the spirit with water before accepting it as rum. All cloudy distillate should be set aside for high wines. The fermentation should then receive attention, and, if necessary, the vats should be limed to secure a clearer fermentation.

The burnt flavour too, is common in the case of fire-heated stills. It is frequently quite unnoticeable in the sample until it has been freely diluted with water. I am convinced from the results obtained at Shrewsbury estate in Westmoreland, that all home trade rums could with advantage be distilled in stills heated by a steam coil. Burnt rum should then be unknown. The fetish of the 'direct fire,' that still lingers in the minds of Scotch whisky distillers has no basis at all where Jamaica rum is concerned, since any excessive firing results in a most serious injury to the spirit produced.

As regards obscuration, there is now a demand for fully coloured rums (say No. 19 on Lovibond's scale) with an obscura-

tion not exceeding $1\frac{1}{4}$ to $1\frac{1}{2}$ per cent. of proof spirit. This is readily attainable if care be taken in preparing the colour.

CLASS III. EXPORT TRADE QUALITY.

Jamaica has long been famed for its rum, and a certain proportion of the crop has for very many years found its way to the markets of Europe. Thirty or forty years ago, a trade in high-class drinking rums was carried on with the continent; and I recently interviewed in Hamburg a merchant who had in former days done a good trade in choice marks of Jamaica drinking rums. He bemoaned, however, that this trade had practically ceased since 1889, when the German Government raised the duty on Jamaica rums from a very low rate to the relatively high one that now obtains, which is equivalent to about 8*s.* per liquid gallon. From that time the entry into Germany of Jamaica rums, suitable for direct consumption, has been made almost impossible. The low rates of excise on the domestic potato and grain spirits render the competition of home trade qualities of Jamaica rums with the German spirits out of the question under present conditions.

To the firm of Finke & Co., of Kingston and Bremen, and the enterprising planters of the north side of the island, belong the credit for having met this obstructive tariff by the development of a considerable trade in high-flavoured rums, of such remarkable blending power that they could stand the high import duty, and yet be utilized by the German blenders for producing a blended rum capable of competing with local distilled spirits subject to a merely nominal excise.

It is no exaggeration to say that to this enterprise alone is due the survival of the small estates on the north side, despite their great disadvantages as sugar-producing estates under the stringent conditions of the sugar market during the past ten years. There is much unreasonable prejudice against this industry among planters who are interested in home trade rums; and it has often been suggested that these high-flavoured rums are merely adulterants, and gain a profit at the expense of the genuine common clean drinking rums.

If these rums were used for blending with silent spirit in the United Kingdom, to produce blends that were sold as Jamaica rum, there would be some ground for this view; but so far as evidence can be obtained, it would appear that these rums are all used on the continent, and are not in competition with home trade rums at all.

As the only discrimination in the United Kingdom against our colonial spirit is the surtax of 1*d.* per gallon, there is no adequate inducement to the blenders to use high-flavoured rums at high prices for the English market.

The evidence of Mr. Steele, C.B., and of the official statistics of the German importations of Jamaica rums, all indicate that our high-flavoured rums, even when sold in London, or shipped to buyers in London, eventually pass on to the continent either in the original puncheons, or as vatted rums.

These export rums are commonly known as German-flavoured rums in Jamaica, and are produced by a process that could only be adopted on a small estate with a relatively enormous distillery capacity. Instead of thirty hours' fermentation, as in the case of a Demerara or Trinidad rum, these German-flavoured rums demand a fermenting period of fifteen to twenty-one days.

The yeasts at work are of the fission type entirely, and the whole process is operated under intensely acid conditions. It is remarkable that these fission yeasts should be able to attenuate a liquor with an acidity of 3 per cent., while the oval budding yeast may be paralyzed with an acidity of less than one-fifth of this amount.

These flavoured rums contain, as might be expected, a relatively high proportion of ethers. Some makes are as low as 600 or 700 parts of ethers, but are, as a rule, relatively rich in heavy-bodied ethers, and are possessed of great stretching power.

The finer qualities contain some 1,000 to 1,200 parts of ethers, and occasional samples may even attain a standard of 1,500 or 1,600 ethers. We have found that about 97 per cent. of these ethers are acetic ether, about 2 per cent. consist of butyric ether, traces of formic ether may be present, and from $\frac{1}{2}$ to $\frac{3}{4}$ per cent. of the total consists of heavy ethers derived from acids of high molecular weight.

It is upon this small trace of heavy ethers that the chief character, and, indeed, the commercial value of a high-flavoured rum depend.

As a rule the presence of high ethers is also associated with that of higher alcohols of a peculiar spicy and attractive fragrance.

Were these rums merely dependent on acetic and butyric ethers for their peculiar value, it is obvious that our trade would be at the mercy of any and every competitor.

The higher ethers, however, have such an intensity of aroma and flavouring power that they entirely dominate all other constituents; and the more we study the chemistry and the manufacture of German rums the more convinced do we become of the great difficulties in the way of reproducing them at will.

No two estates produce the same character of flavour. The differences are due to the variation in the bacterial flora, and these again are dominated by the differences in the composition of the material fermented, and the conditions under which it exists.

This manufacture is peculiarly precarious and erratic, both as to yields and to quality of produce. It is no unusual thing to find successive batches of rum from the same estate, apparently produced under identical conditions, varying in value

from 8s. to 4s. per gallon. When the complicated process is studied, and the entire absence of all rational control is realized, it is only surprising that the results are not far less uniform than they are.

The trade in these rums puts a high premium on the judgement of the buyer, and the science of rum smelling is found in its highest refinement in the valuation of high-flavoured rums. To attain a high measure of efficiency, long training and experience are necessary. A delicate or highly sensitive nose is not so necessary as a faculty for the memory of smells. A good flavoured rum presents to the sense of smell a blend of various distinct types of smell in a proportion that is both attractive and satisfying to the trained nose.

An analytical faculty must be developed whereby the ingredients may be sorted out, and approximately appraised by the trained nose under various headings.

Thus a good standard of acetic ether, associated as a rule with a high standard of ethers and intensity of flavouring power, is appraised under the heading 'pepper' or 'rasse,' that is, breed. This is best appreciated when the spirit is smelt before being diluted. Butyric ether gives a delicate fruity flavour, and rums deficient in this ingredient are sometimes described by brokers as 'stalky.'

Homologues of caprylic ether are apparently the constituents of the pine-apple flavour; while 'fruit' and 'butter' are other characteristic types of smell that reside in the heavy residual ethers.

The heavier ethers are more readily appreciated when the rum is diluted with an equal volume of water. This dilution at once reduces the vapour tension of the acetic ether, which then becomes greatly reduced in pungency, while the heavy oily ethers come out and assert their remarkable predominance.

We must regard the acetic and butyric ethers merely as media for the conveyance of the heavy smell of the residual ethers, and as being of very secondary importance in themselves, although constituting 99 per cent. of the total ethers in the rum.

The chemists present will, I think, concede that the chemistry of the residual and characteristic flavours of these rums is a matter of very serious difficulty to investigate, owing to the extremely minute proportions in which these intensely aromatic compounds exist in the rum.

I will now circulate for your examination a series of samples of German-flavoured rums illustrating the various types at present being produced in Jamaica.

The blenders on the continent would purchase five or six of these different rums, and blend them into a general purpose mixture, capable of being blended with silent spirit to give a blended rum of attractive style, quality, and flavour.

It would appear that the bulk of the so-called rum consumed on the continent of Europe is prepared from artificial essences, and that the trade in 'Kunot rum' has been detrimental to the interest of the Jamaica high-flavoured rum. The experiment station has been experimenting—with some success—in the direction of increasing the blending value of these rums so that they can compete on more equal terms with the sophisticated article on the continent.

An experiment has been carried out at Hampden estate in St. James to test this matter, and although the commercial results are not yet complete, we have every reason to believe that in the direction of increasing the blending power of our flavoured rums must lie the future of this industry.

WEST INDIAN AGRICULTURAL CONFERENCE, 1907.

(CONTINUED.)

CACAO INDUSTRY.

The cacao industry of the West Indies ranks second in importance to that of sugar, the exports in 1905-6 being valued at about £1,400,000. Cacao forms practically the sole crop of Grenada, and in Trinidad is worth about double the value of sugar. It is also an important industry in Jamaica, St. Lucia, and Dominica, while in St. Vincent it is one of the crops that has received attention in connexion with that colony's land settlement scheme.

The botanical establishments have played an important part in the remarkable progress that has been made with this industry, and in an article on the 'Cacao Industry in the West Indies' in the *West Indian Bulletin* (Vol. V, pp. 172-7), it was pointed out that from the Botanic Stations at Dominica, Montserrat, St. Lucia, St. Vincent, and Tobago, no fewer than 20,608 cacao plants had been distributed during the year 1902-3, and 29,874 in the year 1903-4.

The Imperial Department of Agriculture has paid considerable attention to the cultivation of cacao, and manurial experiment plots have been maintained in Grenada, St. Lucia, and Dominica, and what may be called the sample plots of cacao have been cultivated at the expense of the Department. These have become the central points for giving information to cultivators in the district, and should prove of value in bringing about an improvement in the quality of the product shipped, by demonstrating and encouraging better methods of cultivation and preparation.

A brief review of the results of the experiments is here given by the officers directly connected with them.

RESULTS OF THE RECENT EXPERIMENTS WITH CACAO IN THE WEST INDIES.

GRENADA.

The following paper on the results of plot experiments with cacao in Grenada has been prepared by Mr. R. D. ANSTEAD, B.A., Agricultural Superintendent, Grenada:—

In Grenada, experiment plots of cacao are of two kinds, distinguished, for the sake of reference, by the terms 'experiment plots' and 'experiment stations.'

The experiment plots, as was explained at the last Agricultural Conference (*West Indian Bulletin*, Vol. VI, p. 66), are each about 1 acre in extent and are chosen from land, near the public roads, belonging to peasant proprietors.

The experiments carried out upon these plots are conducted by the Imperial Department and are designed to run for three years, the cost of them being defrayed from Imperial funds.

One series of these plots has completed its three-year course, and at present a fresh series, chosen on the same plan but in different localities, is nearing the end of the first year.

The results obtained by means of these plots are highly satisfactory. The Agricultural Instructor uses them as a rendezvous when he is in the district, and as demonstration plots. Here he is able to meet the peasants and to show them how agricultural operations such as forking, drainage, and pruning should be carried out, and how manures should be applied.

Considerable interest has been shown in the plots by the neighbouring peasants, and the operations carried out upon them are imitated to an encouraging extent. The plots are originally chosen in poor areas and where trees have been considerably neglected, in order that the benefits of scientific treatment may be the more marked. A good crop serves as an excellent object-lesson to all cultivators of cacao, and indicates how the most satisfactory results are to be obtained. From one plot, of an area of 1 acre, this year, for instance, the owner has picked two-thirds of the total crop derived from 5 acres of land.

With regard to the actual results of the experiments, figures are kept as accurately as possible, and published from year to year in the Annual Report of the Botanic Station; but from a purely experiment point of view, and as a means of obtaining accurate numerical results, the second class of experiments—the 'experiment stations'—should afford better opportunities than the experiment plots, since they are on a bigger scale and are run more on estate lines.

These experiment stations are established on large estates and consist of not less than 5 acres, or 1,000 trees. The cost of the experiments is borne by the owners, the Imperial Department supplying scientific advice as to the experiments and

the manner in which they should be conducted. These stations, of which there are at present five, have become very popular, and next year a number of others will be started.

The result of establishing them has been to make the larger proprietors take a lively interest in scientific experiments carried out on their own estates—experiments designed to answer questions and solve problems connected with their own soils and conditions.

It is as yet too early in the history of these experiments to be able to give with any confidence numerical results, but two facts are already apparent; firstly, that cacao grown on the heavy red clay soils of Grenada responds quickly and liberally to applications of lime; secondly, that pen manure, when applied in heavy dressings and thoroughly and deeply forked in, is of considerable value and gives results that compare very favourably with mineral and chemical fertilizers.

DOMINICA.

EXPERIMENTS IN THE MANURING OF CACAO.

The Hon. FRANCIS WATTS, C.M.G., D.Sc., etc., has prepared the following brief paper, embodying the results of manurial experiments that have been conducted with cacao at Dominica:

The experiments which have been carried on in manuring cacao at the Botanic Station, Dominica, by Mr. Jones and myself have afforded some interesting and important results. They were begun in 1900 when a plot of about $1\frac{1}{4}$ acres, occupied by trees about ten years old, was divided into five plots for the purpose of manurial experiments as follows:

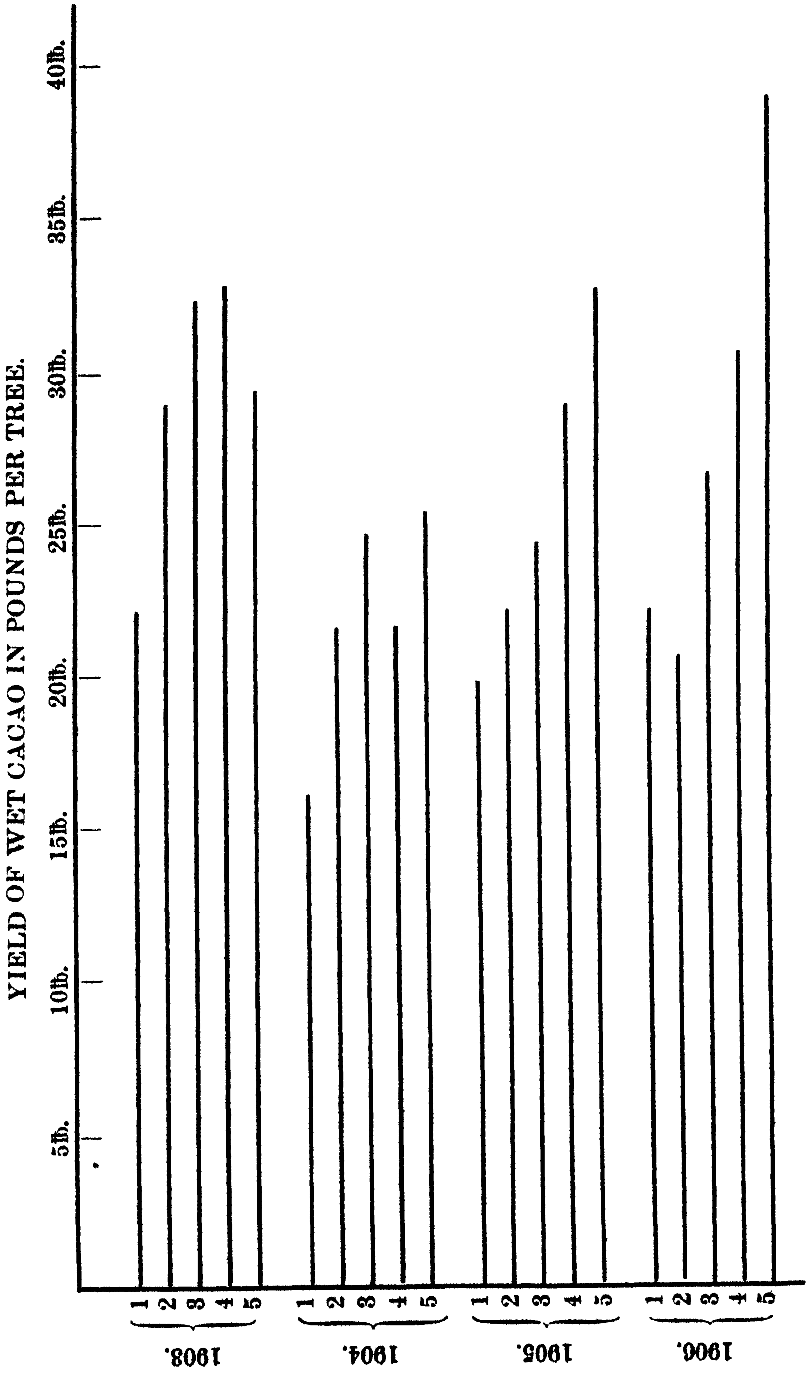
No.	Letter on Station plan.	No. of trees per plot.	Manure.
1	C.	34	No manure.
2	A.	37	Basic phosphate, 4 cwt. per acre. Sulphate of potash, $1\frac{1}{2}$ cwt. per acre.
3	B.	40	Dried blood, 4 cwt. per acre.
4	E.	34	Basic phosphate, 4 cwt. per acre. Sulphate of potash, $1\frac{1}{2}$ cwt. per acre. Dried blood, 4 cwt.
5	D.	39	Mulched with grass and leaves.

The results obtained during the past four years are briefly set forth in the following table:—

YIELD OF WET CACAO IN POUNDS.

No.	Manure.	1903.		1904.		1905.		1906.		Difference on no manure in 1906.	
		Per plot.	Per tree.	Per plot.	Per tree.	Per plot	Per tree.	Per plot.	Per tree.	Per plot.	Per tree.
1. C.	No manure	759	22·3	548	16·11	673	19·76	748	22·00		
2. A.	Phosphate, and potash	1,063	28·7	808	21·83	814	22·00	763	20·62	+ 15	− 1·38
3 B.	Dried blood	1,281	32·2	970	24·25	970	24·25	1,056	26·40	+ 308	+ 4·40
4 E.	Dried blood, phosphate, and potash	1,104	32·4	738	21·70	979	28·79	1,040	30·59	+ 292	+ 8·59
5. D.	Mulched with grass	1,145	29·3	962	24·60	1,170	32·79	1,519	38·94	+ 771	+ 16·94

The results, based on the yield per tree, are also given in diagrammatic form for convenient comparison:—



As 100 lb. of wet cacao are found to yield 42 lb. of dry cacao, and as the trees are planted about 18 feet apart, or at the rate of 134 trees per acre, approximate calculations may be made as follows: –

YIELD PER ACRE IN 1906.

	Dry cacao. Pounds per acre.	Gain over no manure in pounds.	Value of increase over no manure at 6*d*. per lb. of dried cacao.		Cost of manure.		Gain by manuring.	
			s.	d.	s.	d.	s.	d.
1.	1,238	...	...		..		...	
2.	1,160	-78	-39	0	45	3	-84	3
3.	1,486	248	+124	0	36	0	+88	0
4.	1,722	484	+242	0	81	3	+160	4
5.	2,191	953	+476	6	60	0	+416	6

These results have been fully discussed in the Report of the Botanic Station, Dominica, 1905-6, and the notes have been reprinted in the *West Indian Bulletin* (Vol. VII, pp. 201-12); it is therefore, not proposed to discuss them at great length here, but merely to dwell on the salient points.

The experiments show that it is profitable to use manures to cacao trees and that nitrogenous* manures are valuable; the use of phosphate and potash without nitrogen does not appear to be particularly beneficial as shown by comparing plots Nos. 1, 2, and 3. The results to be obtained in the future from plot 2 are awaited with interest. Comparison of plots 3 and 4 demonstrates the fact that potash and phosphate are useful and profitable when used in conjunction with nitrogen, but the experiments do not show whether both of these are necessary.

The most striking and profitable results have been obtained from the use of mulchings of grass and leaves, the gains from which have been phenomenal, and are such as deserve the careful consideration of planters.

As stated in the reports, the mulch is applied once a year; it is spread evenly over the surface and is allowed to incorpor-

* Dried blood is used as the nitrogenous manure: it would seem desirable, on general grounds, to use nitrogenous manures of a slowly available character. Amongst those suitable may be mentioned cotton-cake meal, tankage, and similar substances.

ate itself with the soil by natural agencies: it is not buried or forked into the soil; the thickness of the mulch, even when freshly applied, rarely exceeds 1 inch.

The soil between the trees has not been dug or forked for a number of years; but, under the action of the mulch, it is improving in condition and appears to be in excellent tilth. It is a matter for consideration and experiment whether this complete absence of forking or other tilling can be permitted to advantage on other soils. I am inclined to think that it may be to a larger extent than is commonly supposed, provided that mulching is thoroughly carried on.

In young cacao fields, a good deal of mulching material may be obtained by the careful use of the grass and weeds growing between the young trees. These weeds must be carefully managed so as to avoid injury to the cacao trees, around which clear spaces should be carefully maintained; the weeds should be cut down at frequent intervals and either allowed to lie as a mulch on the surface, or be lightly buried. The space between the trees should be forked or otherwise tilled occasionally, as circumstances may determine; but I believe it will be found that, as the trees cover the ground and the roots extend, cultivation will become less and less necessary if mulching is properly attended to.

In places where the rainfall is deficient, there may be some danger that a growth of grass and weeds on the open spaces between the cleared spaces around the trees may cause undue drying of the soil. This point would require to be carefully watched by the cultivator.

When the cacao trees have so covered the land that an insufficient quantity of vegetable matter for mulching is produced upon it, it becomes necessary to bring material from outside. In many cases this presents no serious difficulty, for in places like Dominica there is an abundance of forest and waste land from which grass and bush can be collected. In other places, it may be desirable to consider the question of growing suitable material for mulching purposes.

The results reported, appear to indicate that the cacao crop of Dominica, to which the experiments more immediately apply, may be very largely increased by the very simple expedient of mulching. The increase may be expected to add a very large sum to the revenues of the cacao fields in the island, and there is reason to suppose that the methods indicated may be widely applicable in West Indian cacao cultivation.

The experiments on these plots are being continued. The results for the current year, which will terminate on June 30, 1907, show promise of being equally interesting, and the yield of the mulched plot is expected again to be in excess of that of the others.

Other manurial experiments with cacao in Dominica are not yet sufficiently advanced to admit of conclusions being drawn from them. In experiments relating to trees it is necessary to carry on the work for a number of years before reliable results can be obtained.

Those interested in these experiments are referred to Annual Reports of the Botanic Station at Dominica, to the articles in the *West Indian Bulletin* (particularly to the article on the Manurial Value of Weeds in Cacao and Lime Orchards (Vol. V, pp. 287-8), and to the summary of the results of Manurial Experiments with Cacao in Dominica, reprinted from the Botanic Station Report (Vol. VII, pp. 201-12).

VARIETIES OF CACAO.

The following paper by Mr. JOSEPH JONES, Curator of the Botanic Station, Dominica, contains information in respect to different varieties of cacao, and experiments that have been conducted in grafting cacao at Dominica :—

Those who have read the history of cacao cultivation in the West Indies cannot fail to have noted the difficulties of the early growers. We are told how the early cacao groves in Trinidad and Jamaica were struck by 'blasts,' and ruin followed.

The variety of cacao first grown was the Criollo, the best kind, but very susceptible to any adverse conditions. We are further informed that thirty years after the blight had destroyed the cacao in Trinidad, hardier varieties bearing an inferior quality of cacao were introduced, and succeeded admirably. These varieties were the Forastero and Calabacillo, which to-day are cultivated so largely in the British West Indies.

At the present time Criollo cacao only appears to be grown on any scale in favourable localities on the mainland of Central America. Its produce is of the highest quality, but the tree is delicate, and the yield per tree is low. This is compensated for by the high prices which this variety fetches.

From time to time attempts have been made to grow Criollo cacao in Dominica, but success has never followed any of them. Planters who have tried to grow it express regret for what experience teaches them was wasted effort.

The growing of the Forastero and Calabacillo varieties of cacao in the West Indies has been a great commercial success. Although the beans are inferior and, in the Calabacillo, extremely bitter, there is still a great demand for it, and it pays to grow. Cacao growing to-day is one of the soundest industries in the West Indies, from the commercial side; but from a plant improvement point of view, cacao may be said to be a story of defeat.

Commencing with the best kind, the planter has been forced back upon the Forastero variety, a hardier type yielding a lower-grade produce. Very large plantations of this exist to-day, but the variety appears to be weakening. Investigations made by scientists, at the instance of planters, have shown how numerous are the enemies of the cacao tree. Several of these diseases have been described and their seriousness has been pointed out. One or more of them may become virulent at any time and inflict great loss on planters. The

ravages caused by the 'Witch Broom' disease in Surinam must be fresh in the memory of all interested in these matters.

Some planters now grow the Calabacillo variety alone, on account of its hardiness and freedom from disease. Those who know by experience how harassing is the presence of the 'canker' and kindred diseases in a plantation will understand why planters prefer hardy trees and a low-grade produce, to delicate trees bearing high-grade produce.

The cacao grower has, by a variety of circumstances, been forced backwards, and it now behoves him to take steps to win back a portion of the position that has been lost.

The method of propagating cacao is the same to-day as always practised. Good pods from trees showing some desirable quality are usually selected and sown. Such seedlings if planted under good conditions commence to bear in five or six years and reach their prime when twelve to fifteen years old. Owing to cross-fertilization very few are exactly like the parent, and seed from one Forastero tree will produce plants of the Forastero type and all its sub-varieties. It is due to this fact that it is not possible to take full advantage of trees for propagation purposes that sometimes appear in plantations, and are known by their hardiness, freedom from disease, and good bearing qualities.

BUDDING AND GRAFTING OF CACAO.

It is important that when trees showing desirable qualities have been noticed and have been tested for a number of years, these types should be fixed and perpetuated. This can be done by budding and grafting.

The Botanical Department of Jamaica has shown that the budding of cacao can be done under certain conditions. The Botanical Department of Trinidad recommended the grafting of cacao some years ago.

Experiments conducted at the Dominica Botanic Station show that grafting cacao by approach can be fairly easily carried out. A tree of a good type is selected, and rough stages are erected round it at varying heights, in such positions as to be able to obtain a maximum of young shoots to graft on the stocks which have already been grown in nurseries in bamboo pots. The pots are placed on the staging, young shoots of the cacao tree of the same age and thickness as the stocks are carefully denuded of their leaves at the point where they are to be fitted to the stocks, a portion of the bark is removed with a sharp knife from both scion and stalk, and the two are gently but firmly bound together with garden tying. A small piece of bark is cut from the stem of the scion below the graft so as to make it more dependent on the stock and to hasten the union. In short, it is simply the well-known system of grafting mangos by approach, applied to cacao.

At certain seasons, with good healthy stocks, cacao can be grafted in six weeks, but the average time may be placed at about ten weeks. The plants must be watered daily. When

ready to be taken off, they may be planted in the field at once or may be removed to a shady nursery and watered daily until the time of planting.

At present the only stocks available are the Calabacillo and strong Forastero kinds. *Theobroma bicolor* has been tried as a stock and has failed. It is posible, if the known species of *Theobroma* could be brought together, that one or more might prove hardier than *Theobroma Cacao*, and at the same time, suitable as a stock on which to graft the commercial kinds.

It will of course be more costly to plant a field of cacao with grafted than with seedling plants, but the advantage should rest later with the grafted plants. Nothing should be used for propagation but prolific, well-tried kinds, that have shown themselves resistant to the diseases now prevalent in cacao plantations. Some of the advantages that should be won by this method may be stated below :—

(1) A planter would be able to grow fields of plants of one selected strain, the beans of which would require the same degree of fermentation.

(2) It would be possible to propagate disease-resisting varieties.

(3) Grafted plants, well cared for, should fruit earlier than seedlings, thus giving a quicker return on capital invested.

(4) The return per acre should be increased by the selection of prolific types.

(5) The effect of grafting may tend to dwarf the plants. This would be an advantage in islands which suffer from much windy weather.

(6) The growing of grafted selected cacao combined with intensive cultivation would be the high-water mark of successful cacao cultivation.

Over 200 grafted plants have been taken from two selected trees in the Botanic Station. Sixty have been planted in the gardens. These will be carefully watched and the results recorded later. A number of these are the Alligator cacao (*Theobroma pentagona*) worked on Forastero stocks.

On estates where the area of cultivation is being increased each year, the system mentioned above should be tried. It should be a recognized part of estate work to propagate by grafting the best strains of cacao. Botanic Stations cannot in this instance supply large quantities of plants, because cacao plants in bamboo pots cannot be conveyed long distances by road in islands like Dominica, without considerable expense, and probable injury to the plants. Intelligent youths should be trained to carry out this work, as has lately been done at the Botanic Station, Dominica, for a manager of an estate in the country. He remained for a few weeks, and has now returned to do good work in this direction, it is hoped, for his employer.

ST. LUCIA.

CACAO EXPERIMENT PLOTS.

The following brief account of the cacao experiment plots at St. Lucia was prepared by Mr. J. C. MOORE, Agricultural Superintendent, and gives a summary of the results that have been obtained in that island:—

In St. Lucia, three 1-acre cacao experiment plots, maintained by the Imperial Department of Agriculture, have successively demonstrated, in three of the principal cacao districts, the cultural and manurial treatment most likely to convert unfruitful, diseased, and neglected trees, into healthy and profitable ones.

On one plot the trees were old and neglected; the stems numbered about eight to the clump. It was described as the worst piece of cacao in the locality; but by judicious treatment, including thinning, pruning, shading, annual forking, weeding and burying weeds, draining, and manuring, the productiveness of this plot was, in three years, increased from 56 lb. to 1,100 lb. of cured cacao.

The manures were applied during the first year (1901) and consisted of 10 cwt. of basic slag, and ½ cwt. of sulphate of potash in February, 5 cart-loads of pen manure in April, and 1 cwt. of sulphate of ammonia in July.

The cost of cultivation and manures during this period was £14 13s 0*d*., and the value of the crops, £45 10*s*. 0*d*.

The second plot consisted of seven-year-old trees in a diseased and failing condition, in the Soufrière district. The cultural operations consisted of thinning, pruning, forking, etc., as in the previously described plot.

Its history is as follows:—

	Yield of cured cacao.	Manures used.
When taken over	Nil	
1st year	217 lb.	1 ton sheep manure. 1½ cwt. sulphate of ammonia.
2nd "	236 "	2 cwt. sulphate of potash.
3rd " ...	343 "	10 cwt. basic slag. 1 cwt. sulphate of ammonia. 3 tons stable manure.
4th "	717 "	4 cwt. basic slag. 1 cwt. sulphate of ammonia. 10 tons village refuse.
5th "	1,081 "	4 cwt. basic slag. 1 cwt. sulphate of ammonia.

The cost of cultivation and manures during these five years was £84 7s. 4d., and the value of the crops produced, £64 17s. 0d.

The third plot was a mixture of old and young trees (the latter about seven years old) in a neglected and dying condition, at Roseau. It had produced no crop for some time previous to being taken over, but with careful cultivation and by the judicious application of manures, the following results were obtained:—

	Yield of cured cacao.	Manures used. No organic matter was added to the soil beyond the buried weeds.
1st year	360 lb.	8 cwt. basic slag. 1 cwt. sulphate of ammonia.
2nd „	650 „	2 cwt. sulphate of potash.
3rd „	765 „	8 cwt. basic slag. 1 cwt. sulphate of ammonia.
4th „	580 „	4 cwt. basic slag. 1 cwt. sulphate of ammonia.
5th „	450 „	2 cwt. sulphate of potash.

The cost of cultivation and manures was £30 17s. 5d., and the value of the crops produced, £70 5s. 0d.

On another estate, not under the Department's supervision, similar cultural and manurial treatment on 38 acres of old cacao resulted in a net profit of £180 for nine months, over and above the average crop reaped from the plantation before manuring was commenced. The benefit to the general health and bearing capacity of the trees is said to have increased their value by £500.

SUMMARY OF RESULTS.

From the results obtained on these and other plots in the island, the following conclusions may be drawn :—

1. That intensive culture in cacao is very profitable, as regards monetary returns. It also improves the vigour and disease-resisting powers of the trees.

2. That on St. Lucia soils, phosphates and nitrogen, in the form of basic slag and sulphate of ammonia, increase very considerably the productiveness of the trees.

3. That better results have been secured where pen manure or other suitable organic manure has been used, in addition to basic slag and sulphate of ammonia.

4. That in most St. Lucia plantations, efforts should be directed towards increasing and subsequently maintaining the supply of organic matter in the soil.

5. That the yield of cacao in St. Lucia from an estimated area of 6,200 acres, now yielding on an average, about 300 ℔. of cured produce per acre, could be trebled by means of high cultivation costing, on an average, from £5 to £6 per acre per annum. This means that from the present acreage the cacao, exports could, in four or five years time, be raised from 9,500 bags (1905-6 crop) worth (at 6*d.* per ℔.) £47,500, to 28,500 bags, worth £142,500. In addition to this, the value of the cacao properties would be greatly enhanced.

YIELD OF CACAO IN TRINIDAD.

A brief paper on the yield of cacao in Trinidad has been prepared by the Hon. CARL DEVERTEUIL for the purpose of discussion at the Conference :—

It has often been stated that the yield per acre of cacao in Trinidad compares somewhat unfavourably with the yield of other cacao-producing countries. The object of this paper is to bring forward the few reliable details with reference to this subject.

In Trinidad, estates are bought and sold on the number of trees. The value of a property depends on the number of full-bearing trees. The area is rarely, if ever, taken into account, and the yield of cacao per tree or per acre is never considered.

Distances at which cacao trees are planted vary from 10 to 16 feet. Twelve feet may be taken as the average, although there is now a tendency to plant at distances of 14 feet, for experience has shown that in good cacao land, the yield per tree is better when the plants are farther apart.

The yield of 10 bags per 1,000 trees on a well cultivated estate is considered to be poor, whereas 13 to 15 bags per 1,000 trees are considered to be a fair yield, and several properties have been known to yield from 20 to 22 bags. (A bag of cacao is taken to be 1¾ cwt.)

Ten bags to the 1,000 trees mean but a yield of about 2¾ to 3 bags to the acre, varying with the distances at which the trees are planted apart. In 1906, a committee was appointed by his Excellency the Governor to inquire into the labour conditions at Trinidad, and in their exhaustive report, it is stated (Clause 50) that the acreage under cacao is unknown. In Clause 62, attention is drawn to the practically entire absence of statistics relating to agriculture.

In the Blue-book of 1904-5, the acreage under cacao is given as 190,000 acres.

The acreage alienated in the seven years 1898-1904, practically the whole of which was for cacao cultivation, is stated to have been 91,251 acres. As it takes from eight to ten years, at the very least, to bring land from forest into full-bearing

cacao cultivation, it is quite clear that the total acreage given above cannot be taken into account when computing the yield of cacao per acre. From personal observation, it may be stated that a very large acreage of land alienated from the Crown twenty years ago is still uncultivated.

The labour committee (Appendix U) estimate the acreage in bearing cacao at 77,000 acres, and the export for 1904-5 (a good year), and 1905-6 (a very poor year), is calculated at 271,260 bags and 226,237 bags, respectively. Assuming that the figures arrived at by the Labour Committee after a careful inquiry are correct, it will thus be seen that the average yield per acre for these two years is equal to 3¼ bags per acre. This, I think, compares favourably with the yield of every cacao-producing country, when it is taken into consideration that a large quantity of the cacao is planted in unsuitable soil, and that very small attention is given to careful cultivation by a large number of proprietors.

It should be mentioned that the figures given above as to the exports of cacao have been reckoned in both cases from September of one year to October of the next, for this period covers the whole crop, and does not, as in the case of those obtainable from the Blue-book for the financial years, involve the accumulation of half of the crop of one year and half of the crop of the next.

THRIPS ON CACAO.

BY H. A. BALLOU, M.Sc.,

Entomologist on the Staff of the Imperial Department of Agriculture.

Thrips are small insects of the order Physopoda.

They are slender, with two pairs of narrow, membranous wings which are fringed with hairs. The metamorphosis is incomplete; the mouth parts are intermediate between the biting and the sucking forms. The thrips of cacao (*Physopus rubrocincta*) is from $\frac{1}{18}$ to $\frac{1}{25}$ inch (1-1·5 mm.) in length when full-grown. The adults are dark-brown or black, the young being pale-green or yellowish-green with a bright-red transverse band across the abdomen.

Thrips on cacao was first investigated by the Imperial Department of Agriculture in November 1900, when Mr. Maxwell-Lefroy, then on the staff of the Department, visited Grenada in connexion with an outbreak of thrips. Mr. Lefroy paid a second visit to Grenada to continue his investigations of this pest in March 1901 (*West Indian Bulletin*, Vol. II, pp. 175-90).

In December 1901, an article by M. Aug. Elot appeared in the *Revue des Cultures Coloniales*, entitled 'A new enemy of Cacao.' This gives an account of the occurrence of thrips in Guadeloupe in 1898 and 1901. The article deals with the damage done to cacao trees by thrips, the measures to be adopted for its suppression, and includes a technical description of the insect by M. Gaird, who, finding that it was new to science, proposed the name *Physopus rubrocincta*, by which it is still known. The occurrence of thrips in Guadeloupe is referred to in the *West Indian Bulletin* (Vol. II, p. 288), where M. Elot's report is summarized, and the statement is made that 'the geographical distribution of thrips, as known at present, is Grenada, St. Vincent, St. Lucia, Dominica, Guadeloupe, and possibly Ceylon.'

Thrips injure cacao by feeding on the leaves and pods. The mouth parts of thrips are intermediate between those of insects which bite off particles of food, which they chew and swallow, and those of insects which are provided with a proboscis by means of which they puncture the tissues and suck the juices of the plant or animal tissues on which they feed. Thrips have one large well-developed and one aborted or rudimentary mandible. By means of the large mandible they cut or puncture the surface tissues and then suck or lap up the juice or sap. Thrips feed on the underside of the cacao leaves, and generally in groups or colonies. The position of these colonies is marked by a discoloured spot on the leaf. Examination shows that the green cells of the leaf have been destroyed by the feeding of the thrips. When the pod is attacked the result is slightly different. The minute wounds inflicted by thrips in their

feeding are healed up by the growth of the pod, with the production of a dark, corky material. When the pod has been badly attacked there is sufficient of this dark-coloured material to give the pods the characteristic mahogany or russet appearance which is characteristic of thrips' attack.

Thrips may be frequently seen with the abdomen elevated, bearing at its tip a drop of excrementitious matter which is from time to time deposited on the surface of the leaf or pod. When this dries, it forms a very small thin flake, which helps in the discoloration. This is however readily distinguished from the russet appearance.

The manner of egg laying of the cacao thrips is responsible for other wounds to the plant. The adult female is provided with an ovipositor composed of two plates with saw-teeth edges. Although I have not seen the actual process of egg laying, nor seen it described, it seems probable that the eggs are deposited in cuts or incisions made by the ovipositor in the tissue of the leaf or pod.

If the leaves of a thrips-infested cacao tree be examined at the time when the young leaves are coming out, it will be found that on the young leaves there are many adult thrips, while on the old leaves there will be seen few adults, and many colonies of young. Both young and old are found on the pods.

The explanation seems to be this: As the young leaves appear, the adult thrips migrate to them, there to lay their eggs. In this way, the eggs would be laid on the tenderest parts of the plant, and the thrips larvae would have the best possible chance for feeding. Probably, much the same habit prevails in the egg laying on the pods, although the period of growth of the pod is sufficiently long for the development of several generations of thrips.

The attacks of thrips on the leaves of cacao are sometimes sufficiently severe to cause the leaves to fall off, but on the pods the effect seems to be very slight, the principal loss seemingly being from the picking of discoloured pods as ripe. When pickers have learned to distinguish between ripe pods and unripe ones which are discoloured by thrips attacks, there is but little apparent loss from this cause.

Lefroy stated (*West Indian Bulletin*, Vol. II, p. 183) that the cacao thrips is found on leaves and pods of cacao and on leaves of cashew, guava, and Liberian coffee in Grenada, and on cacao in St. Vincent, St. Lucia, and Dominica. It is also found on cacao in Guadeloupe, and I found it on wild guava and cotton in St. Lucia. As an additional note of interest, it may be mentioned that I have found both winged and wingless forms of adult female thrips. So far as I have seen, the males are always winged, and of a lighter colour than the females.

TREATMENT.

The treatment of thrips naturally falls under two heads: the application of insecticides for the direct control of the insects, and cultural methods for the improvement of the general health and vigour of the cacao trees.

So far as thrips' attacks are recorded, these are always much more severe when they occur under certain conditions. In seasons of extreme drought and in localities where for any reason the health of the cacao trees is impaired, thrips' attacks are liable to be experienced, while in seasons of favourable rainfall, and in cacao orchards where all matters of good cultivation, such as draining, forking, pruning, and manuring receive careful attention, thrips are rarely prevalent.

From this it will be at once concluded that the matter of first importance is the health of the trees, and in the case of an outbreak of thrips, careful attention should be given to these points.

Rainfall conditions cannot be controlled, but by thorough attention to cultural practices, a condition of the trees and of the soil can be maintained which will make them much less susceptible to the effects of continued drought, on the one hand, and of excessive rainfall on the other.

Another operation that should be included under cultural methods consists in the destruction of all wild and useless trees growing in the vicinity of cacao cultivations, which are likely to be infested by the cacao thrips. The plants on which this insect is known to occur are, cashew, guava, Liberian coffee, and wild cotton. If any of these occur as valuable plants, it might pay to treat them for the destruction of thrips in the same way that the cacao trees are treated.

If it becomes necessary to spray cacao for the better control of thrips, one of the washes given herewith might be used.

On account of the extremely uneven and rugged character of the ground in many cacao orchards, spraying could be performed only with difficulty, and since careful attention to cultural details will generally restore the trees to health, even in case of severe attacks of thrips, it may probably follow that spraying will be resorted to only in orchards favourably situated, and then only to serve as a check on the pest while the results of manuring, draining, forking and pruning are being developed.

Insecticides with directions for preparing them, were given in the Appendix to Lefroy's report (*West Indian Bulletin*, Vol. II, p. 185) but may, with advantage, be reproduced for general information :—

1. *Rosin Wash.*

Powdered rosin	4 lb.
Caustic soda (77 per cent.)	1 „
Fish oil	¾ pint.

Mix these, cover with about 2 inches depth of water and boil till all is dissolved. Then add water *very slowly* to the liquid, keeping it continually boiling until the whole is made up to about 3 gallons. This is stock solution. For use, add 6 gallons of water to 1 gallon of stock solution.

Amount of wash, 21 gallons.

2. *Kerosene Emulsion.*

Hard soap	...	...	½ lb.
Kerosene	...	...	2 gallons.

Boil the soap in 1 gallon of water till it is dissolved. Take it off the fire, at once pour in the kerosene, and churn the mixture with a force pump or syringe for ten minutes. This is stock solution. Add 9 gallons of water to 1 gallon of the stock solution.

Makes 30 gallons.

3. *Kerosene Emulsion with Whale Oil Soap.*

Use 1 lb. of whale oil soap in place of ½ lb. of hard soap as in No. 2.

4. *Rosin and Whale Oil Soap Compound.*

Rosin	...	...	4 lb.
Washing soda	..	...	3 ,,
Whale oil soap	...	...	10 ,,

With the rosin and soda make 4 gallons of rosin compound stock solution as above. Stir the whale oil soap in 5 gallons of hot water; mix the two while hot. This is stock solution. To every gallon add 4 gallons of water. An alternative method is to make the rosin compound stock solution. For use, mix 1 gallon with 10 gallons of water and stir in 2½ lb. of whale oil soap. Every 45 gallons of wash should contain the above ingredients, however mixed.

Of these I should recommend Nos. 1 and 3 as likely to be most effective.

APPENDIX.

The following extracts from correspondence with various officers of the Imperial Department in Grenada and Dominica in respect to treatment of thrips and the occurrence of 'russet' pods are of interest, and are here produced as an appendix :—

'On the road leading to the experiment plot (Mountain-road) in the vicinity of Providence estate, I saw cacao trees the leaves and fruit of which were being attacked with thrips. On the lower road, fields, or more correctly speaking, portions of fields have been badly attacked with this pest. I am recommending heavy dressings of pen manure, and, where necessary, more drains. It is only since the spell of dry weather that these insects have attacked cacao trees in numbers, causing them to cast some of their leaves, as for some time they have been dormant on a large portion of the island.'

(Sgd.) GEORGE F. BRANCH,
Agricultural Instructor, Grenada.

'On Waltham Experiment Station, section (1), treated with lime, seems to have most fruit on the trees.

'I noticed the appearance of thrips on this side of the island also. As far as I could observe, places on which the trees are

well kept and a high standard of cultivation is maintained, with the exception of the staining of pods, no serious harm seems to have been done up to the present time.'

(Sgd.) GEORGE F. BRANCH,
Agricultural Instructor, Grenada.

'The climatic conditions appear to be very favourable to thrips, which have spread considerably during the past month. Many planters have told me that these conditions always mean a 'Thrips year.' This is what I should expect since the drought has checked the growth of the trees, and I notice that if trees attacked by thrips are made to put on a quick and vigorous growth by tillage operations, or otherwise, the thrips soon disappear.'

(Sgd.) RUDOLPH D. ANSTEAD,
Agricultural Superintendent, Grenada.

'In reply to letter No. 4,077, I beg to say that it is quite possible that the 'bronze' or 'russet' appearance of cacao pods is not always caused by thrips. I have seen cacao pods badly attacked on cacao trees growing in damp, dark ravines, where the annual rainfall is 175 inches. It is hardly likely that thrips could exist under such conditions.

'On the other hand, at the Botanic Station cacao pods are only attacked during the dry season when thrips are undoubtedly present. The round smooth pods of the Calabash cacao seem to suffer more than the Forastero varieties.'

(Sgd.) J. JONES,
Curator, Dominica.

'I have the honour to acknowledge your letter No. G. 4,078 dated November 26, making inquiries with regard to the 'russet' appearance of cacao pods in the absence of thrips.

'In reply I beg to inform you that, though I have examined many pods having this appearance, I have never found a case where there was no evidence of thrips, if not on the pods themselves, then on neighbouring trees or wild plants. The Agricultural Instructor, with whom I have discussed the question has had exactly the same experience.

'I have made a point of asking as many planters as possible about this since the receipt of your letter, and none have known, or heard of, a case of this 'russet' appearance in the absence of thrips.

'It is however to be noted in this connexion, that thrips are so prevalent in Grenada that it would be difficult to find any large area which was free from their attacks, so that if thrips and some other disease, such as your letter implies, were present together, the latter would be most difficult to detect from the appearance of the pods alone.'

(Sgd.) RUDOLPH D. ANSTEAD,
Agricultural Superintendent.

FRUIT INDUSTRY.

ORANGE INDUSTRY OF THE WEST INDIES.

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The following facts connected with the West Indian orange industry may be of sufficient importance to engage the attention of the Agricultural Conference, and it is hoped that a discussion of them may lead to satisfactory results.

As you are aware, some years ago a great advance was made in the prosecution of the industry in Dominica by the extensive planting of budded Washington Navel and other fine varieties of oranges. Mr. Hesketh Bell, who was then Administrator, and his brother-in-law, Mr. J. F. Scully, planted budded oranges in large numbers on their estates, and other proprietors followed their lead in the matter.

The Imperial Department of Agriculture greatly assisted this new planting enterprise by publishing, as pamphlet No. 37, the paper on 'Orange Cultivation in Dominica,' read by Mr. Hesketh Bell at our Society, and by making proper provision at the Botanic Station for the continous supply of budded plants. The result was that many thousands of Washington Navel orange trees have been established in the island.

This year considerable shipments of the fruit were made to the London market, and the brokers reported on them as follows: 'The oranges were very nice indeed and nicely packed. The conditions necessary for planters to secure success had been fulfilled, but unfortunately, the prices proved unsatisfactory on account of the market being flooded with shipments of about 30,000 boxes of Jamaica oranges, many of which were reported to be selling at prices which do not even cover the freight.'

Now this state of affairs must be as unsatisfactory to Jamaica shippers as it is to Dominica ones, and it will be of very great benefit to so important a West Indian industry if measures can be devised to prevent the total loss to growers that results from their fruit being sold at prices that do not even cover freight.

It has been suggested that Jamaica shippers should take the matter into their own hands, and prevent their fruit being sold on the market for less than a minimum remunerative price. As Jamaica practically holds a monopoly of the London orange market during the months of August, September, and October, it is in a position to dictate its own terms. It is a question between sellers and buyers; and, should buyers refuse to pay the minimum remunerative price fixed, then the

fruit might be given away to the hospitals and other charitable institutions, or disposed of otherwise.

The loss of a few shipments in this way would show buyers that the growers were in earnest, and the loss would be made up before long by the healthier trade relations that would result from such action.

HOW TO ENCOURAGE ORANGE TREES TO BEAR EARLY IN JAMAICA.

BY THE HON. T. H. SHARP, Jamaica.

I think it a fair estimate to say that not more than 20 per cent. of the oranges produced in Jamaica are exported, and that of this quantity fully 10 per cent. cause losses to the shippers by shipping late. This sad state of affairs is probably due to the fact that during the time when the foreign market requires the fruit it is not mature here, and when our fruit is fully matured and fit for market, competition by other fruit causes such a glut that losses occur.

If oranges can be got fully matured and exported in the months of July and August they command a high price. Hitherto, we have been shipping immature fruit during those months and obtaining better prices than could be obtained for beautiful fruit later on.

Suggestions have been made by persons in authority who are not traders, and who do not understand what it means to send oranges into a market when they are not required, that nothing should be shipped except it is mature, because it brings a bad character on the country. It is however probable that as long as a good price can be obtained for the oranges, be they ever so unripe, it is better to ship them and realize than to hold back until they are well matured and fully ripe but not in demand on the market. It has also been contemplated by those who do not fully understand the trade, that legislation should be resorted to, so as to prevent the shipment of immature fruit. The orange, however, is a perishable article, and therefore, the buyer governs the market and not the seller.

Before suggesting any means by which the tree may be encouraged to bear early, I should like to draw attention to the fact that it is probable that there is hardly a day in the year in the island of Jamaica when a few first-class ripe oranges could not be obtained. What is the cause of this?

There is no period fixed for the maturing of an orange rom the time the blossom appears until it is fully ripe; it all depends on the conditions obtaining. Generally seven months may be relied upon.

Whenever an old orange tree is about to die, it makes a last effort to reproduce itself by bearing heavily.

Fruit buds at all times are lying latent in the trees, and the general idea that the tree after bearing its crop has to take a long time before it can make its fruit buds is probably erroneous. In Jamaica, there is a partial rest for vegetation. It is of a spasmodic nature and greatly depends upon the cold winds after the heavy 'fall' rains.

There may be said to be two distinct energies in a tree: one the energy of reproduction, the process of which causes the production of fruit, the seed of which carries on the life; and another, the energy for the formation of the tissues. One of these two energies may often be observed to predominate over the other, either in bearing fruit or in growing tissues solely; or they may run concurrently, when it may be observed that the tree is growing and bearing at the same time. The varying exercising of energies is brought about by varied conditions, and, therefore, artificial means should be resorted to in order that conditions may be produced to force the energies to predominate one over the other as required.

Pruning causes the energy for the formation of tissue to act, and a shock to the system causes the energy of reproduction to be exercised. In the first case, it may be observed that soon after pruning a good deal of young shoots are produced, and it may be seen that the shock to the system of the tree causes it to force out the latent fruit blossoms. The latter has often been brought about by accident, such as by a fire scorching a part of the tree, or by a waggon wheel running up against it. The cutting away suddenly, of large over-hanging shade trees, or the dumping of a large quantity of fermenting manure against a tree has often produced the same results, and, therefore, bearing these points in mind, it has been shown that trees can successfully be caused to blossom when required. Old congested trees in the parish of Manchester have also after treatment been caused to bear at the proper season.

Orange trees taken in hand immediately after the 'fall' rains should have all dead wood and unhealthy branches and fruit pruned off. This should be done about the last week in October. If your tree responds to the treatment by a heavy flow of sap, which is easily recognized by the appearance of young shoots and the colour of the leaf, you will know it is healthy.

Checks to the growth of the trees, such as could be caused by bruises, etc., would make them blossom, and having once got an early bearing from your trees, they will most likely continue, with the adoption of simply pruning and cultivating, to bear early, and it may be anticipated that it will not be necessary to bruise the trees more than once in every four or five years.

PINE-APPLE GROWING IN THE WEST INDIES.

BY G. L. LUCAS, Jamaica.

The growing for export of pine-apples in the West Indies has never been successfully accomplished, except in the Bahamas, and in the island of Cuba.

The Bahamas for many years were large producers and exporters of pine-apples. All the fruits were sent to Baltimore in schooners in bulk to the canning factories, but of late years the industry has steadily failed, until now the shipments from these islands have become small.

The Bahama Islands are composed of coral rock, and the little soil at any time could be only found in the crevices of these rocks. Repeated plantings have exhausted what little soil there was, until now the planter in these islands is confronted with the problem of how to continue an industry that at one time proved so profitable.

The Government some years ago passed a law forbidding the exportation of any more pine-apple plants, hoping by this means to save the declining industry, but government laws have failed, because it was the exhaustion of the soil and not the loss of plants that was responsible for the decline.

Florida, in 1883, produced no pine-apples except on the outlying keys from which, like the Bahamas, the produce was shipped in bulk to Baltimore in schooners to the canneries. In 1884, the few settlers on the eastern mainland of Florida began the experimental planting of suckers that were obtained from the Florida Keys. Later, as the business grew and the demand for plants increased, the Bahama Islands were drawn upon and many hundreds of thousands of plants found their way to Florida to commence the industry that to-day forms one of the principal sources of revenue of that state.

The Florida pine-apple grower in all these years has had many discouragements to contend with, and, aside from poor soil, the greatest enemy has proved to be frost. With this menace constantly confronting it, the business has been kept in check and no doubt will always be kept within certain bounds.

Cuba produces more pine-apples than Florida, the Bahamas, and the West India Islands combined, and the export of this fruit is increasing rapidly every year. It pays the planter in Cuba to grow pine-apples because of the extremely fertile soil, and the frequent, cheap, and quick transportation to the United States, where a reduction of 20 per cent. on the duties is allowed on this fruit. Little success could be expected from shipping fruit from the British West Indies to England with the present unsatisfactory means of transportation, for the reason that the journey is too long, freight rates are too high, and private shipments generally receive indifferent care by the transportation companies.

Jamaica enjoys direct communication with England by a subsidized line, but this line gives the greater amount of attention to the carriage of bananas so as to fulfil its contract with the English and Jamaica governments. Private shippers, therefore, receive secondary consideration, and experience in the past has shown that losses are frequently incurred. During the past three years, such have been the experiences of those who have made earnest and repeated trials of private shipments that now no individual shipments are made in the fruit line from Jamaica.

Probably the best way of establishing a profitable pine-apple business in Jamaica would be to build canning factories to utilize the fruit on the spot. This can be done by growers combining and erecting a modest factory. Encouragement should then be offered to others to grow good fruit, which would be purchased for cash delivered at the factory, at a price that will pay the grower handsomely and allow the factory to earn a fair percentage on the investment. There is always a good demand for canned pine-apples in England, and large shipments of such goods are sent from Singapore every year to both London and Liverpool. If Singapore can make the canning of pine-apples a profitable business, with its cheap labour, there are other advantages that are enjoyed by the West Indies that the East can never hope to have. I think that if this subject be given the consideration it deserves, a new industry that can be depended upon to yield revenue to many of the West India Islands would be the result.

A canning factory was erected in Jamaica in 1905, and it has given successful results. Many obstacles were encountered before the business could be made profitable; mistakes were made and losses incurred.*

Another canning factory is now being erected in Trinidad, which may prove a profitable investment to those who have had the courage to lay out their money in a new enterprise. Every encouragement should be given the promoters by the planters in Trinidad, who, if they planted largely, would find ready sale for all their fruit at remunerative prices.

ESTABLISHING FIELDS.

To establish a pine-apple plantation needs some knowledge as to the proper methods to follow, and although Cuba produces millions of fine pine-apples, the methods of laying out fields in Cuba are somewhat crude.

The Cuban method is to plough the land, turn up ridges about 8 feet apart as for sweet potatos, and then to plant the pine-apple suckers along the top of these ridges about 8 inches apart in the rows. This method of planting is not to be recommended, for the plants are too far apart between the rows and too close together in the rows. The plants receive no support

* The late earthquake destroyed all the stock of goods that had been made up, and which happened to be stored in the city of Kingston.

from one another and when they fruit, the weight causes them to turn over. In consequence, the fruit becomes sunburned, the plants become uprooted, and the suckers find much difficulty in striking their roots into the soil. The fields soon deteriorate, as the sun bakes the soil and burns the roots of the plants.

The Cuban possesses an idea of drainage but his understanding of this necessary part of pine-apple cultivation is very crude, and it might be anticipated that if he only knew more about the proper cultivation of pine-apples, much better results would be obtained.

After twenty-four years devoted to the growing of pine-apples both in the sandy soils of Florida where no drainage is ever needed, and a long experience in Jamaica where the soils are heavy and where thorough drainage is absolutely necessary, I have to make the following observations for the guidance of those that are about to embark upon the cultivation of pine-apples:—

The prospective pine-apple grower should select his soil with the greatest care. The best soils are probably light loams, rich in humus. A heavy cold soil, or soil inclined to become sticky or gummy in wet weather should never be chosen. Look for what is a good scouring soil containing sufficient sand to make it pliable at all times, and it is advisable that it should slope gradually. Hilly parts should be passed by.

First the land should be thoroughly ploughed, then cross ploughed, and harrowed until it is thoroughly pulvarized and freed from the smallest lumps. A wheel or disc harrow is the only tool that can get such land into proper condition. This should be followed by an Acme harrow which will smooth and level the land. A tooth harrow should not be used, for this tool only pulls out the grass and weeds, and brings to the surface trash, which is best left in the soil to assist in enriching the land.

After the land has been prepared, mark off with a line for trenches. These trenches should be 14 inches wide and 14 inches deep, and should follow the slope of the land in order to afford proper drainage. The trenches should be 12 feet apart, they should be made perfectly straight and in line, and all soil taken from them is best thrown equally on both sides in order to build up the beds. This soil then should be raked towards the centre of the beds and brought somewhat higher in the middle than at the sides, so as to allow a difference of about 6 inches between the height in the middle and that along the edge of the trenches. A fine-tooth steel rake should be used and the beds should be made as smooth and even as possible.

When the trenches and beds have been completed, mark off each bed into checks 18 x 18 inches. This will give about nine rows along the beds. The cross checks should be made regularly except at intervals; two lines can be omitted so as to allow for paths. These marks should be made with a wooden marker and they should be perfectly straight to facilitate subsequent cultivation. The plants are then dropped at the

intersection of each mark. They are then ready for the planter, who with a good strong trowel, follows along and sets the plant at each cross mark at a depth of one-fourth of their length. This depth of planting is to be recommended no matter what the length of a plant. If planted too shallow, they will not become sufficiently rooted, and heavy winds will blow them out of the ground; and if planted too deeply they are liable to be smothered by having the soil filling the hearts. Suckers or slips that are longer than 12 inches can be lopped off and brought down to 8 inches so as to facilitate rapid planting and to prevent their being blown out of the ground before they have taken root. If the suckers are not planted in strictly straight rows each way, they should be pulled up and planted again. If the labourer who plants them is charged for his mistakes, he will be more particular in future as to getting them perfectly straight.

CULTIVATION.

After the plants have been set out, they can be left alone for five to six weeks to allow them to become well rooted, unless weed growth becomes too vigorous. If weeds become at all prevalent, the beds must be hoed without delay, for during this early stage of growth weeds and grass should never be allowed to grow or get ahead so as to cause the plants to receive a check, as plants that have their growth checked at this early stage rarely, if ever, recover.

Nothing but a push or scuffle hoe should be used in the cultivation of pine-apples. A special hoe, 10 inches wide and about 3 inches deep and sharpened on both sides, with a handle about 8 feet long, has proved a very useful tool.*

The hoer should be a careful worker and should be instructed to stand in the trenches between the beds. He should never be allowed to walk among the plants or to trample down the soil. The usual method of cultivation is to hoe from each side, pushing the hoe between the plants, gauging so that the hoe will cut about ½ inch beneath the surface of the soil so as to cut off every weed or piece of grass showing. Great care should be taken not to disturb the plants by knocking the hoe against them, because when they are just beginning to take root the slightest jar will check their growth.

In about six weeks after the suckers had been planted, they should, under favourable conditions, be showing growth. The best time to plant is probably during June, July, and August. It is frequently a difficult matter to procure plants before July, for the reason that suckers and slips are hardly ripe enough for planting. If gathered immature they are liable to rot.

After the plants show growth, an application of tobacco dust will prove highly beneficial. This dust contains 6 to 8 per cent. of potash, 3 to 4 per cent. of ammonia, and about 2 per

* Such hoes may be obtained from Messrs. Parkes, Birmingham.

cent. of phosphoric acid. Besides being a good fertilizer it is an insecticide, and this makes its use doubly valuable. The best method of applying tobacco dust is to have the labourer handle it in buckets. He carefully walks among the plants and drops a pinch of the dust into the heart or bud of each. This, of course, necessitates walking on the beds, but it can be done with care and the beds can receive another hoeing afterwards. Dust is often applied before hoeing, so that the beds are left in a good condition.

Tobacco dust should be applied at intervals of two to three months in small doses, each application requiring about 600 ℔. per acre if carefully distributed. Such applications can be continued until three months before flowering of the plants, when all applications should cease. As pine-apples generally blossom or show fruit in January, no dust should be applied after October.

GATHERING THE FRUIT.

In twelve to fourteen months fruit should be in proper condition to pick, and if intended for foreign markets, should be gathered green but perfectly full. Experience can be the only guide in picking for shipment, so that a good colour may be obtained, for if pine-apples are picked too green they will never assume a good, rich colour. The method practised is for a picker to go into the fields followed by another man who should have a wicker basket of about one or more bushels to carry the fruit. This man takes each pine-apple from the picker and carefully places it in his basket. When the basket is filled, it is carried either to the packing house or placed in a spring cart or waggon padded with bagging to prevent the fruit from being bruised. It is thought that many growers in cutting the pine-apple from the plant with about 2 inches or more of stalk attached to the fruit make a mistake; for this stalk in a few days, becomes sour, and decays the fruit. The better method probably is to snap the fruit from the stalk. With a little practice this can be done without breaking the stalk, by gently pressing the knee upward under the pine-apple, and with the hand bend the fruit inwards until it snaps from the stalk. (A few slips removed from the side towards which the fruit is bent will cause the pine to snap from the stalk easier, but in no case remove all the slips during the early or later growth of the pine-apple, because they protect the fruit from the sun. Besides, the slips when allowed to grow the proper length are well worth planting and form a valuable asset to the planter.)

PACKING.

When the fruit is delivered at the packing house, it is carefully piled not more than three pines high, on tables or on a clean flour. It is left overnight to cool off before being wrapped. The paper used for wrapping should be tough and strong, but not too thin or too thick. After the pines are sufficiently cooled, they should be carefully wrapped and placed where the packer will be able to get them without

moving from the crates. The crates hold twenty-four, thirty, thirty-six, forty, and forty-eight, according to size (forty-eight size being very small are seldom shipped). Each pine-apple is handled separately, and they are placed head and tail (or top and bottom) alternately in the crate. After the package is filled, the fruit should project about 1 inch above the sides of the crate, and the slats are then nailed. In this operation the slats should be gently pressed down with the knee and never nailed until each slat is firmly pressed down on the sides of the crate; otherwise, bruising of the fruit will result. Too much care cannot be taken in packing and handling all kinds of fruit.

Freight on all shipments must be prepaid, and proper bills of lading should be taken out; shipments for Canada must be accompanied by declaration made out in triplicate on regular forms, copies of which can be obtained either from agents in Canada or from the Imperial Department of Agriculture.

DISEASES.

The pine-apple plant is not affected with many diseases. Blight affects the Ripley and Queen family more than any other kind, and when established is very difficult to cure or to check. It sometimes spreads through fields with great rapidity, and within a short time healthy looking fields may present a withered and ruined appearance.

Black heart usually affects the Ripley and the Queen family, and can rarely be detected until the pine-apple is cut. Black spots are to be found in the fruit that utterly ruin it. The Ripley is extremely liable to this disease.

VARIETIES.

The *Abbakka* is probably the handsomest pine-apple grown, but its quality is very inferior. It is watery and flavourless, and a poor shipper.

Smooth Cayenne.—This is the St. Michael's pine-apple, and the only variety that sells in the London market for the highest prices. This variety cannot be grown with success in the West Indies. It has repeatedly been tried at Jamaica, but has eventually been abandoned.

The Smooth Cayenne will not endure the severe heat of the West Indies, and whilst some few good specimens have been grown, the cultivation has proved a failure. It is a watery pine-apple and is a poor shipper. Its fine appearance only recommends it. It is essentially a hot-house pine, and the expense and great care incidental to its culture in the Azores compels the grower to receive high prices for his fruit.

Sugar Loaf.—This variety is of fine quality, but is too tender to ship with safety. A few grown for local consumption and home use are, however, acceptible. There are other sorts that are misnamed 'Sugar Loaf' in Jamaica, and few persons really know a genuine pine of this variety; but when once shown, the difference between it and other misnamed varieties becomes apparent.

Black Pine or Black Jamaica.—This variety is so worthless that a description is hardly necessary. Suffice it to say that it is a coarse, ugly, watery, and insipid fruit that does not even deserve consideration, except to warn the inexperienced grower against planting it.

Antigua.—This pine-apple is well thought of in Antigua but it is too small, and possesses nothing to recommend it in any way for shipping purposes.

Sam Clark.—This fruit presents a pretty appearance, as it has a tremendous top, but it is only of inferior quality, being small, watery, and insipid.

Red Spanish (erroneously named in Jamaica, *Bull Head, Cow Boy*, etc.,)—This variety, although subject to slight variations, can be safely classed under one head; namely, Red Spanish. This pine-apple is the oldest variety and most extensively grown in the world; it forms the entire crop of Cuba, Florida, and the Bahama Islands, besides growing wild in many of the islands in the Caribbean Sea. It has proved the only profitable pine-apple to grow, and those contemplating taking up the growing of pine-apples will do well to bear this fact in mind. It is the only kind that sells for remunerative prices in the markets of the world. It is a splendid shipper, and, whilst not of finest quality, it possesses a good appearance, and is of a large size. Large crops of marketable fruit may be depended upon, for the plants are practically free from disease, and are vigorous and very prolific in slips and suckers.

CONCLUSION.

The growing of pine-apples is a pleasant occupation, and if followed with care and proper attention, success is not uncertain if adequate transportation or a local demand, such as canning factories, not too distant from the plantation, can be depended upon. Growing pine-apples to be sold at ½*d.* per lb. delivered at the factory will pay the planter fairly well, and will allow the factory to earn a reasonable percentage on the investment.

Sixteen thousand pine-apple plants can be planted on 1 acre, and if the business is properly managed, the fields should produce 80 per cent. fruit in from fourteen to sixteen months. Each pine-apple should average not less than 3 lb., and if the grower is so fortunate as to have a large local demand for his fruit, he will not be under the necessity of going to the expense of buying crates, wrapping paper, nails, and pre-paying freight on his shipments. The business of consigning fruit is not as satisfactory as it should be, and the unfortunate planter is compelled to submit to many an injustice; but in Cuba and Florida, 75 per cent. of the pine-apples and oranges are sold for cash in the fields or in the groves at a contract price, the buyer taking all risk of shipment.

FUNGUS DISEASES OF PINE-APPLES.

BY F. A. STOCKDALE, B.A., (Cantab.),

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The pine-apple cannot be said to be a plant that suffers severely from diseases, yet there are several well-known troubles that often occasion considerable loss, and at times have compelled planters to abandon what promised to be a lucrative pursuit.

Pine-apples at Dominica, Antigua, and Jamaica have all suffered at different times from disease, and it is intended that the following description of the chief diseases of the pine-apple be presented in order to inform planters of pine-apples what diseases to expect, how to recognize them when they appear, and what treatment is likely to prove beneficial in dealing with them. The chief diseases of the pine-apple may be classed under (1) tangle root, (2) blight, (3) black heart or core rot, and (4) diseases of the fruit after having been cut for shipment.

The first is probably not caused by any fungus, but is due rather to unfavourable conditions or to poor preparation of the soil. It has, however, been included in this paper so as to make it as complete as possible, and in order that its symptoms may be compared with those of 'blight.'

TANGLE ROOT.

The symptoms of this disease are known to all cultivators of pine-apples. The leaves turn yellow, commencing at the tips and gradually extending over the whole plant. These then commence to wilt and to dry up.

On looking at the roots of the plants, they will be seen to be wound around and around the body of the plant under the leaves in a tangled mass—hence the name 'tangle root.'

As to the cause of the disease, opinions differ, but it is generally held that it is mainly due to poor preparation of the land, the roots being unable freely to enter the ground. They, therefore, wind around the body of the plant and cause strangulation as the stock expands.

At the Florida Experiment Station it has been found that the Golden Queen and Smooth Cayenne are the only varieties that are affected by this trouble. Whether this is the experience of other countries has not yet been ascertained.

When plants are seen to be affected it is advised to pull off some of the lowest leaves by giving a little twitch sideways, but if the plants show further advance of the disease they should be taken up, trimmed, and re-set in a new piece of land that has received careful cultivation. During last year (1906) the pine-apples at the Dominica Botanic Station received this treatment, and many of the plants have recovered and set good fruit.

BLIGHT.

It is often noticed that rows of pines have their evenness disturbed by the occurrence of stunted plants of a yellowish hue. The younger stages of this disease are marked by the tips of the leaves turning yellow and drying up, while in the older stages the discoloration of the leaves has proceeded further, and the leaves have lost, to a certain extent, their usual turgidity and have become withered. If these plants bear fruit, it is usually small and stunted and assumes a yellowish hue long before the time it should do so under ordinary circumstances.

The plant eventually commences to die and to become rotten. The apical leaves and shoots fall away, or may readily be removed, as they become decayed at their bases of attachment, and frequently the 'suckers' become cut off in a similar manner.

The external symptoms closely resemble those of the 'tangle root' and point to an insufficient supply of water, and hence probably to a root disease.

On taking up a plant that is showing early signs of disease, it will be noticed, on washing the roots, that they are unhealthy, and in many cases appear black and quite rooten. Microscopic examination of an affected root shows that it is covered with root-hairs. This is an extraordinary appearance for old roots, as root-hairs are usually restricted to a small region of the root immediately behind the growing point. These root-hairs, moreover, instead of being obtusely pointed simple cylinders, are terminally irregularly widened and twisted, present a clubbed appearance.

The tips of the roots and rootlets become discoloured and eventually become a pale-brown instead of being white and resilient. They also collapse readily on pressure. This discoloration spreads upwards along the course of the roots. Eventually they become wholly decayed, and this decay can be traced into the stem, where it frequently causes a blackening and rotting of the tissue. The root-hairs are filled with the mycelium of a fungus which is also to be found in the tissues of the root, particularly in the cortex cells between the central cylinder and the external wall.

The root-hairs appear to be the first portions that are attacked, and it would seem that the extraordinary development of root-hairs on the older portions of the roots, mentioned above, is a special effort on the part of the plant to try to replace those destroyed by the fungus. The growth of the fungus is attended by a complete breaking down of the tissues of the roots.

Sections through root-hairs and roots that were showing first signs of the disease reveal the presence of fine colourless threads of the fungus, bearing here and there conidia, which may be sessile upon the threads of the mycelium or supported on slender pedicels.

The fungus that accompanies the discoloration and softening of the roots does not appear to have been identified, and although inoculation experiments have not yet been

carried out, there seems to be little doubt that it may be regarded as the active cause of the disease. It seems to attack the roots in a manner similar to the fungus that causes the wilting of cotton, melon, etc.

Remedial measures :—

In Queensland, it is stated that the continuance of the disease is determined by certain conditions apart from those furnished by the plant itself.* Amongst the circumstances that may possibly contribute to this result are : '(1) adherence to the stock from a single source, with inbreeding as a consequence ; (2) neglect of renewal of plants in individual plantations ; (3) continued cropping of the ground with one kind of plant ; (4) imperfect methods in planting, cultivating, and manuring crops ; (5) influence due to climate and seasonal changes thereon ; and (6) those residing in the character of the soil and its drainage.'

It is more than probable that pine-apple plants, as being the progeny of one stock, gradually deteriorate, thus affording an opportunity for an attack by a disease that would have been withstood if fresh plants had been periodically introduced into the cultivation from other estates where conditions of cultivation, soil, etc., vary from those of the estate in question.

The choice of soil for pine-apple cultivation is of importance for it seems that soils in which the water remains near the surface, especially favour the presence of the disease, and particular care should be given to the cultivation and drainage, for a wet soil, improperly tilled, is detrimental to healthy development of roots, and renders them the more liable to be attacked by parasitic organisms.

Frequently the disease goes on for a considerable period before it causes the death of the plant, but all affected plants are stunted in appearance. Therefore, it is advisable to dig up and destroy all diseased plants, together with those in their immediate neighbourhood; then, after liming thoroughly the soil from which these plants were taken so as to hasten the destruction of any of the fungus or spores that might be present, and allowing the soil to rest for some time, a supply of healthy 'suckers' should be used for replanting.

In the case of valuable pine-apple plants, it might be possible to save those affected, by taking them up, cutting off the lower part of the stem until no more black root ends are visible; and then, after stripping off the lower leaves, replanting in another field that has been carefully cultivated.

Professor Webber, who reported upon disease in pine-apple plants submitted from Jamaica, states that: 'A number of experiments have been tried by various growers working in co-operation with us in digging up the plants when they first begin to show signs of disease, cutting off the bases above the diseased portions and then resetting them. This process, however, has not proved satisfactory, some of the plants seeming to recover while others go back again. We have

* H. Tyron. 'The Pine-apple disease.' *Queensland Agricultural Journal*, Vol. 15, p. 470.

made a few experiments in treating the disease by spraying the bases of the plants and soil with Bordeaux mixture, but results thus far have been entirely negative. At the present time therefore, we can only suggest eradication, the taking out of diseased plants as soon as they appear and replacing them with fresh, healthy suckers.

'We are also inclined to think, from the results of a few experiments, that one of the primary ways of controlling this disease is the rigorous selection of healthy plants. By this means we believe the trouble can be entirely overcome.'*

BLACK HEART OR CORE-ROT.

In 1901, at the third Agricultural Conference, Dr. Watts, in a paper on the Pine-apple Cultivation in Antigua, drew attention to a disease which appears to be of a fungus nature and probably induced by insect attacks. The fruit shows little external indication of the disease but ripens unevenly, particular segments or groups of segments occurring here and there that remain pale-green. whilst the remainder of the surface has assumed the general hue characteristic of a ripe fruit. On cutting across a ripe fruit. that is affected, black patches are found in the pulp that appear to extend from a short distance from the outside towards the centre. These occur immediately opposite the pale-green surface markings already alluded to, but differ greatly in shape as well as both in length and breadth. Later, the pine-apple may present brown patches externally, and during the progress of the disease deep fissures may arise amid the sections, and occasionally two or three affected fruitlets may be partly sunken in the more or less extensive pits that thus arise. In these pits and fissures a green mould may be ultimately noticeable. On cutting across a pine-apple that is in the more advanced diseased condition, the discoloured area may be seen to extend from the outside to a depth varying from $\frac{1}{4}$-$\frac{1}{2}$ inch inwards, and sometimes it can be made out that the diseased areas commence independently, and not simultaneously, in separate fruitlets.

The disease at first commences with the formation of one or two small patches in the stems immediately below the level at which the stamens are inserted. and tends, in some varieties, to invade the tissue occurring laterally to its point or points of origin, and to pass upwards into the fleshy sepals before it extends downwards into the ovary of the fruitlet. If the diseased 'eyes' are examined microscopically, it is found that a fungus—a species of *Penicillium*—is present in each case.

Dr. Brown, in a report on Disease in Pine-apples in Victoria, states that fungi may enter the fruit in four ways: (1) Fungus may enter the flower, and go on developing with the progressive growth of the flower, to form the fruit; (2) fungus may enter through stomata; (3) fungus may enter through the fine membrane of epidermal cells; (4) fungus may enter through a wounded surface.

* Jamaica *Bulletin*, 1901. p. 83.

Examination of diseased pine-apples from Antigua revealed the presence of one or more perforations at the base of the style in the thickened walls through which the fungus in all probability gained entry to the pulp.

In cases where the disease was first visible to the naked eye, the discoloured tissue was always adjacent to the perforations, and when the mycelium reached the cavities of the ovary the characteristic conidial fructifications of *Penicillium* were produced. It would appear to be unlikely that a form like *Penicillium* could penetrate the thick leathery walls of the old floral chamber unless the walls had been perforated in some way or the fungus gained access at a very early stage in the development of the flower.

In Queensland, the Smooth Cayenne variety is affected in a similar manner by a species of *Penicillium*, while an apparently similar disease is produced in the prickly varieties by a mite and a fungus (*Monilia* sp.) where the fungus probably enters the fruit by means of the perforations made by the mite.

In inoculation experiments, carried out in Queensland, by which an attempt was made to produce the disease artificially by sowing the spores of the fungus, it was found that infection would only take place through wounds. It is therefore concluded, that it is necessary, in order that the disease may originate under natural conditions, for some agency by which such injury may be affected to be present.

Information to hand would indicate that the insects commonly present in the 'eyes' of the pine-apples in Antigua are apparently two—a mealy bug (*Dactylopius* sp.), and a mite, the latter of which has the greater puncturing power. In Queensland several species of mites are present, of which *Tarsonemus ananas* has been identified. These are held to cause punctures through which the fungus can gain an entrance into the flesh of the pine-apple and cause it to commence to rot. The mites, therefore, must be regarded as being the originators of the disease. The mites themselves have also been observed to be covered with fungus spores and may, in this way, serve to distribute the disease from plant to plant.

More work is, however, necessary to establish fully the relative importance of the insects and the fungi that cause this disease.

Remedial Measures :—

All plants that show any signs of disease should be rooted out and destroyed in order to prevent them from becoming more diseased and serving as centres of infection to other plants. Their place should be supplied by suckers derived from plants in which this trouble has not previously been remarked. On no account should diseased cuttings be planted and it might be advisable for all pine apple cuttings or suckers to be dipped in a disinfectant, such as Bordeaux mixture, before planting.

If the insects are to be held as the primary cause of the trouble, the plots should be sprayed with a suitable insecticide. Rosin compound is a cheap and efficient insecticide spray for the purpose, while in Queensland a lime-and-sulphur wash is recommended for use.

Mr. Tyron suggests that the lime-and-sulphur wash may be prepared as follows: 'Boil water in a copper; take of good lime and powdered sulphur equal weights; pound the former; mix the two in a little water to a consistency of a cream; then pour this cream-like mixture into the water, whilst this is being maintained in a constant state of ebulition; continue boiling till the lime and sulphur amalgamate and an orange-coloured solution is produced. In making this the exact amount of boiling water is a matter of indifference. but this should not exceed 10 gallons. After this stock solution has been made up, it should be diluted with warm water to such a strength as would be the maximum that the plant will tolerate, as mites do not readily succumb to the action of insecticides.'

The exact strength will have to be a matter of experiment, and would best be determinedby spraying different parts of the estate with different strengths. The spraying with an insecticide should then be followed by spraying with Bordeaux mixture so as to sterilize the eyes for some time and thus prevent the entry of fungi that cause the 'black-heart,' and the spraying should be repeated at least once at the end of a fortnight.

It is quite possible that spraying may have to be undertaken as a regular operation in pine-apple cultivation if first-class fruit is to be raised. Clean and careful cultivation should also be carried out, and in order that spraying may be the more practicable, it may be advisable to make the distance between the rows a little wider than is usually practised.

DISEASES OF SHIPPED OR STORED PINE-APPLES.

It is extremely probable that much of the disappointment which is suffered by shippers of pine-apples is caused through the decay of their produce in transit. Fungi appear to make their entrance in two ways: (1) through bruises on the surface, and (2) through the cut ends of the stalks.

Examination of diseased pines from Antigua by Mr. A. Howard, M.A., one of my predecessors, in the mycological laboratory of the Imperial Department of Agriculture in 1901, showed that many pines present a soft watery condition in certain areas, from which a characteristic fruity smell of ethyl acetate is given off. This smell is probably formed from the sugar of the juice by the activity of a fungus, and the areas after a time become darkly discoloured, due to the spore formation of the fungus. The commonest fungus found in these diseased pines was *Trichosphaeria sacchari*, the rind fungus of the sugar-cane, and it was seen that the sterile mycelium extends to a considerable distance beyond the discoloured area. The extent of the fungus may be determined by the watery appearance of the attacked pulp and by its unpleasant taste. On account of the watery nature of the

decay produced by the fungus, a single damaged fruit might easily affect the whole of a barrel.

Other pines have been examined and show that they had become affected through the cut ends of the stalk. They were infected by a species of *Diplodia* that passes rapidly up the spiral vessels of the central vascular core and spreads from there to the surrounding tissues, producing therein a watery appearance very like that noted in the case of *Trichosphaeria sacchari*. From this, however, it could be distinguished by the lack of smell of ethyl acetate. The older attacked portions become black, due to the mycelium turning a darkish colour with age. The fructifications are visible to the naked eye as small black dots under the rind of the fruit near the stalk end, and consist of pycnidia containing spores which are two-celled and brown when mature.

This fungus which infects pines in Antigua develops rapidly on the voyage, and doubtless is responsible for some of the loss in the fruit during transit.

Moulds caused by species of the common genera *Penicillium* and *Aspergillus* are often found on pines previously affected with *Trichosphaeria sacchari* or *Diplodia* sp., or on those that have been cut too green, when extensive shrinkage takes place and causes the bracts to come apart and expose the tender tissues to the attack of these common fungi.

Remedial Measures :—

As the loss caused by *Trichosphaeria sacchari* can be largely avoided by care in packing, since the fungus gains an entrance and commences its ravages in transit at bruised surfaces, the greatest care should be taken not to pack any bruised pines, since one unsound pine may easily communicate disease to nearly the whole package. The pines should be shipped in a dry condition in well ventilated cases, and should be packed in such a way as to minimise shaking, and the consequent bruising, during transportation.

The fungus *Diplodia* sp. probably gains an entrance to the fruit at the cut end of the stalk and, it has been suggested that if the fruits were snapped off from their stalks this danger does not exist. It might be possible, however, that it could be largely excluded by shipping pines with stalks about 4 or 5 inches long, while in the case of valuable pines, it might be advisable to dip the cut ends of the stalks into hot melted wax or tallow.

ADDENDUM.

Since the above paper was written, Dr. N. A Cobb (late Director of the Division of Vegetable Pathology and Physiology, Hawaiian Sugar Planters' Association) has contributed an account of one of the main diseases of the pine-apple in Hawaii, that accounts for many pine-apples that become diseased on

the plantations, and may also be the cause of some of the slices that have 'gone off' after canning.

It is a soft rot accompanied by a sooty black colour of the watery tissues in the last stages. The earlier stages of the disease are not accompanied by the black colour, for the fungus itself merely softens the tissues and discolours them but little. The black colour of the later stages of the disease is due to large numbers of macrospores of *Thielaviopsis ethaceticus*, Went—the fungus that causes the so-called 'pine-apple disease' of sugar-cane cuttings.

Microscopic examination of the watery tissue at a distance of 2-3 inches from the dark macrospore formation shows that it is mainly composed of the rather dark-coloured mycelium of the fungus. This gives rise to chains of microspores, and later the dark coloured macrospores are produced.

'The microspores arise in the mycelium of lesser diameter and appear to form first in the vicinity of the vascular tissue of the pine-apple.' Inside the pine-apple 'the microconidia are to be seen forming in the mycelium of the fungus, and after they are complete they are pushed forth from the ruptured ends of the cylindrical mycelium,' but when a diseased pine-apple is cut through and exposed in the air, aerial conidia are produced. 'These were in moniliform chains of the most beautiful regularity, the spores remaining joined at the central part of the area between them.' It would appear that these spores were formed by the segmentation of aerial mycelium that had originated internally from other mycelium.

The rot is most common at the base of the fruit and at the top, and is largely determined by insects. Moreover, its spread from one plant to another is largely the result of insect work. In this spread the mealy-bug is said to play an important part.

There would appear to be considerable resemblance to this disease of the Hawaiian plantations to that which has been described in the above paper as 'black-heart' or 'core-rot.' In Hawaii, however, the disease is said to be most common at the base of the fruit or at the top, whereas specimens of 'black-heart' in the West Indies show that any particular segments or groups of segments may become affected.

The recommendations for remedial measures that are given by Dr. Cobb are valuable, and are here briefly summarized:—

The mealy-bug of the pine-apple is most abundant at the base and at the top of the fruit, and, therefore, when tops are removed for the purpose of planting out, the greatest care should be exercised to see that no insects are transplanted at the same time. Remove as many leaves at the base of the cut-off top as may be necessary to secure this end.

All pine-apple refuse should be completely destroyed and all diseased pine-apples should be buried deeply, so that danger of spread from spores may be obviated.

When planting, the removal of the tissues from the lower part of the pine-apple top is to be recommended, as the lowestmost tissues of the new plant will then for some time offer some resistance to the attacks of the fungus should it be

present in the soil; for it has been found that the fungus when it rots in pine-apple at the top does not penetrate beyond a certain distance into the top, doubtless, because the tissues are less suitable to the fungus growth.

Experiments in various sugar-growing countries have shown that cane cuttings can be protected from the 'pine-apple disease' fungus -*Thielaviopsis ethaceticus* by the application to their ends of Bordeaux mixture or tar, and it may be possible that the disease of pine-apples could be prevented from attacking freshly planted sets by the adoption of a similar method. In fact, it is probable that the smearing of the cut ends of all pine-apple slips with Bordeaux mixture or tar might be generally performed with benefit.

LIME JUICE INDUSTRY.

CITRATE OF LIME AND CONCENTRATED LIME JUICE.

BY THE HON. FRANCIS WATTS, C.M.G., D.Sc , F.I.C., F.C.S.,

Government Analytical Chemist and Superintendent of Agriculture for the Leeward Islands.

Interest in citrate of lime has recently increased in the West Indies from the fact that the article is now being made and shipped on a fairly large commercial scale from the islands of Dominica and Montserrat. In previous papers,* I have discussed the details of its manufacture, and have little to add to what has been already said except, perhaps, that it might be found that a well-prepared juice, free from pulp and charred matter, might find direct application in some of the arts, and thereby command a higher price.

One somewhat important point has however been brought to my notice by one of the West Indian makers of citrate, namely, that hot lime juice filters readily through suitable cloth. This fact admits of application in the manufacturing process. In making citrate it is desirable first to heat the juice in a still so as to recover the essential oil, which is a valuable commodity; after distillation the hot juice can be run through filters, which may advantageously be made on the lines of the well-known Taylor-bag filters commonly used in sugar manufacture. The clear, filtered juice is then used for the preparation of citrate in the manner previously described.

Another useful suggestion, for which I am indebted to the same gentleman, is that the juice can be readily and economically heated by blowing naked steam into it, and that, by using a suitably perforated pipe, the steam so agitates the juice as to obviate the use of any mechanical stirrer. It is preferable to let the steam into the juice on one side of the mixing vat so as to cause a regular circulation. If the juice is brought into the mixing vat as soon as possible after leaving the still, so as to retain a good deal of heat, the dilution caused by the naked steam is reduced, and therefore the filters should be arranged to retain the heat as much as possible. Mixing vats of wood answer the purpose admirably.

The best forms of drier appear to be those in which warm air is drawn over the citrate deposited on shelves; these driers are of the type of cacao driers described in the *West Indian Bulletin*, Vol. II, p. 173.†

As regards the relative advantages of making citrate or concentrated juice, I have nothing to add to what I said in the *West Indian Bulletin*, Vol. III, p. 152. The question appears to me to be still an undecided one.

* *West Indian Bulletin*, Vol. II, p. 308, and Vol. III, p 152.

† Driers of this kind are made by the Blackman Export Co., Ltd., 70, Finsbury Pavement, London, E. C.

In order that those interested in the subject may form some idea of the appliances required for the manufacture of citrate, I append here plans for a citrate factory capable of dealing with a crop of about 12,000 barrels of limes, equivalent to a crop of about 100 casks of concentrated juice.

Considerable improvements may be effected in the manufacture of concentrated juice. In the first place, the juice should be freed from pulp and suspended impurities before concentrating. This is now found to be a comparatively simple matter. It is usual to heat the juice in a still in order to recover the essential oil. When the distillation is finished and the hot juice discharged from the still, it is readily clarified either by allowing it to stand in vats to permit the suspended impurities to subside, or preferably, it may be passed through bag filters in the manner mentioned above.

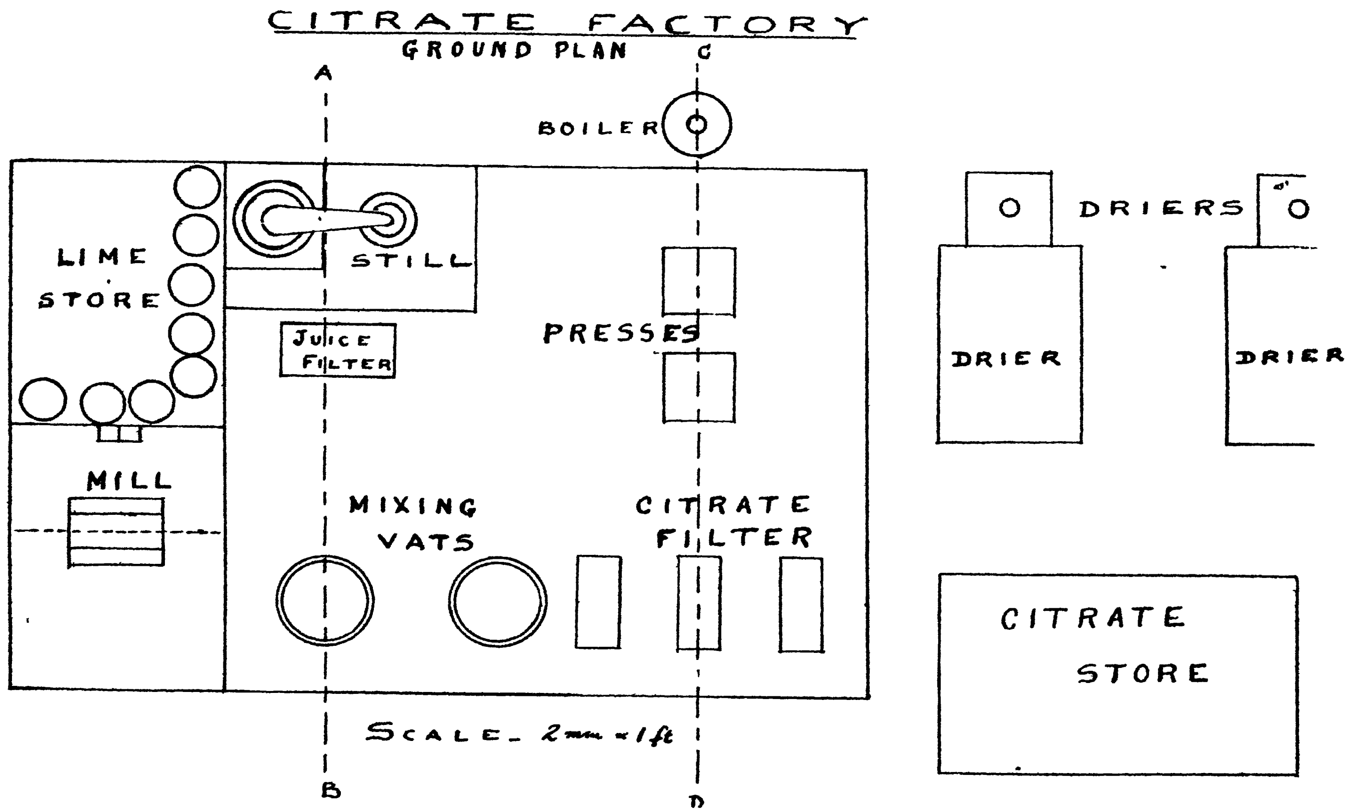
Concentrated juice prepared from clarified lime juice is comparatively free from suspended impurities, and is a superior article to much of the concentrated juice now commonly placed on the market. Some suspended impurities are present, however; these result from the action of heat on the juice in the process of concentrating.

It is important that the concentration should be controlled by means of the citrometer in the manner described in the *West Indian Bulletin*, Vol. II, p. 309, which briefly is this: 'Carry on the concentration until the citrometer, when immersed in the juice at the boiling temperature shows a density of 60°.'*

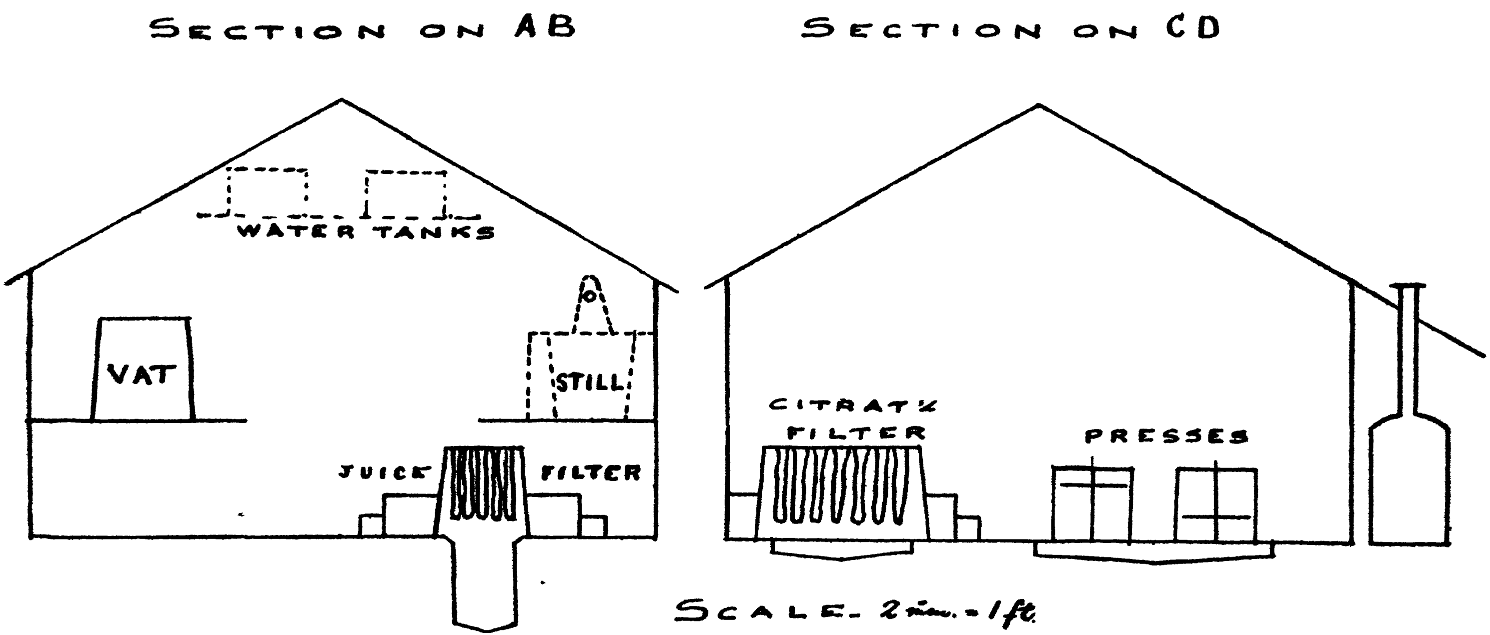
A much finer product would be obtained if the juice were concentrated in steam-heated pans instead of over open fires. It is suggested that shallow wooden vats heated by steam coils of copper or block-tin will serve for this purpose. I have not seen such appliances in use, but the suggestion is one well worthy of consideration and should commend itself to planters for trial.

I am informed that there is a demand for the better qualities of concentrated lime juice for direct use in various arts and manufactures in the place of crystallized citric acid. This is of importance, for, if a fine quality of concentrated juice, of good colour and free from suspended impurities can be placed on the market, it is reasonable to suppose it will be in demand for those purposes in which a solution of citric acid can be employed in place of the crystallized acid, and should command a higher price than ordinary concentrated juice.

* Citrometers may be obtained from Messrs. Baird and Tatlock, 14, Cross Street, Hatton Gardens, London, W. C.; Messrs. J. Long & Co., East cheap, London, E. C., or from most dealers in chemical apparatus.


CITRATE FACTORY
GROUND PLAN
A
B
C
D
BOILER
LIME STORE
STILL
JUICE FILTER
PRESSES
MILL
MIXING VATS
CITRATE FILTER
DRIERS
DRIER
DRIER
CITRATE STORE
SCALE – 2mm = 1ft

CITRATE FACTORY



SCALE – 2 ins. = 1 ft.

ADDENDUM.

THE USE OF CENTRIFUGALS FOR DRYING CITRATE.

Until recently I was of opinion that it was sufficient to press the wet citrate in bags in order to remove the superfluous water before putting the citrate in the drier. I have, however, recently had an opportunity of conducting some experiments with citrate, as produced on a commercial scale, and have ascertained that a centrifugal will remove a considerable quantity of water from citrate which has already been well pressed.

The experiments were conducted with a model centrifugal having a basket 5 inches in diameter and run at a speed of about 3,000 to 3,500 revolutions a minute; thus developing a centrifugal force of about the same intensity as that obtained in large centrifugals in commercial use.

The experiments also demonstrated very clearly that citrate can be handled very conveniently by means of centrifugals. The centrifugal employed for the experiments was lined with twill cloth, of the kind used for press cloth. There was no tendency for the citrate to force its way through the cloth, and the water was removed with striking rapidity. The centrifugal removed a considerable quantity of water from citrate which had already been well pressed.

The citrate may be washed very conveniently in the shortest space of time and with the minimum amount of hot water while it is still in the centrifugal, thus producing a pure citrate of good colour.

It has frequently been noticed that citrate dries with difficulty when it has been so handled as to produce a plastered surface on the lumps. The press has a little tendency in this direction, but careless handling may accentuate this condition. Citrate which comes from the centrifugal is in a dry pulverulent state in which it dries rapidly, and the resultant dried citrate is freed from lumps, and is softer and more friable than that which had been pressed.

The advantages to be gained by the use of the centrifugal may be summed up as follows:—

a. Convenient and rapid handling.

b. Rapid and thorough removal of water.

c. Convenient washing.

d. More rapid drying in drier, and consequent saving of time and fuel.

e. Better condition of finished citrate.

Where citrate of lime is made on a large scale I have no doubt that the use of the centrifugal instead of the press is to be recommended, for it should be found very materially to improve the conditions of working.

CITRATE OF LIME.

Mr. JOSEPH JONES, Curator of the Botanic Station, Dominica, has submitted the following note on citrate of lime in Dominica:—

The manufacture of citrate of lime in Dominica was taken up a short time ago by one firm, and the results of these initial experiments have proved very satisfactory. The citrate was favourably reported on in London, and the analyses showed 69 per cent. of citric acid.

The quantity of citrate of lime exported from Dominica to December 30, 1906, was 728 cwt., valued at £1,555, and so successful have been these early efforts that very considerable development along these lines may be expected in the near future.

At present, the bulk of the lime juice produced in Dominica is concentrated for export. Under this system there is a great loss of acid. If citrate of lime is carefully made, there should be a very small loss of citric acid, and although it is more expensive to manufacture, it is a superior product and commands a higher price than concentrated juice.*

It is probable that along the Leeward side of Dominica, where transport by water is but rarely interrupted by bad weather, a factory or factories for making citrate may be erected, and the raw juice purchased from the estates and small growers. Provided the planter has an interest in the factory such a development is to be hoped for.

The preparation of lime juice would then be separated from estate's work, and the planter would have more time to attend to the cultural and manurial requirements of his lime trees.

The highest commendation is due to those planters who by making citrate, or by preparing a very pure concentrated juice, are seeking to raise the quality and the value of the products of the lime industry in Dominica.

* It is calculated that in making concentrated juice the loss of acid may be about 6 to 16 per cent. under conditions of careful working, whereas in making citrate it may perhaps be put down at about 2-3 per cent. Making citrate requires more care and skill than is necessary for the manufacture of concentrated juice, and the cost of the chalk has to be added to the cost of working. There is probably little or no saving in fuel in making citrate, no saving in freight, and possibly little saving in packages. [Ed. *W. I. B.*]

LIME JUICE CONCENTRATION.

The following brief note on lime juice concentration has been prepared by the Hon. J. C. MACINTYRE, of Dominica, and should prove of interest:—

The need for improving the quality of West Indian concentrated lime juice has long been apparent, and during the last few years attention has persistently been directed to this fact by Dr. Watts, merchants, and others interested in the sale of the product.

It has been pointed out that the great difference between the price of Sicilian and West Indian juice, amounting usually to about £3 per hhd.,* is very largely due to the indifferent preparation of the latter, for it usually contains large quantities of pulp and foreign matter, and carbonized juice due to excessive concentration.

Efforts at improvement have usually taken the direction of attempts to clear the raw juice and have invariably resulted in failure for the following reasons:—

(1) Raw juice takes long to settle, and therefore very large storage capacity is necessary. This alone would render the adoption of this method impossible on most estates.

(2) Subsidence is never complete, it being only possible to draw off as clear juice 60-65 per cent. of the entire quantity, and the residue, a thick mass of pulp and oil, defies every effort at economical treatment.

It was not until attention was directed to clearing the juice after distillation that any substantial improvement was effected. The process of distillation removes the oil, and if the juice is then run into subsiding vats, the pulp as well as a good deal of the gummy matter contained in the juice, rapidly settles to the bottom along with the heavier impurities. The supernatent liquid can, after the lapse of a few hours, be drawn off perfectly clear, and the remaining juice recovered from the sludge, with which it is mixed, by the use of 'browers' filters.

These filters are merely canvas bags enclosed in one outer casing of loosely woven twine. They are cheap, simple, and quite efficient.

Clearing juice in this way adds practically nothing to the cost of manufacture if the works are suitably arranged. In my works the juice is pumped from the mill into vats placed high up in the boiling house, thence it pours into the still and and from that into the subsiding vats. These are fitted with taps 8 inches above the bottom for drawing off the clear juice, and a plug hole in the bottom for removal of the sludge. After

* Market quotations are made as for a pipe of 108 gallons, of 64 oz. of citric acid per gallon. West Indian concentrated lime juice is shipped in packages of half this size, but inasmuch as the juice contains usually about twice the quantity of acid, it is customary to regard the quotation as referring to a hogshead of West Indian juice, and it has been so treated here.

subsidence, the clear juice is run into the tayche and the sludge thrown up into filter tanks, from which the filtered juice finds its way also to the tayches.

During the first season my entire crop was treated in this way; and that the results were satisfactory may be judged from the remarks of Messrs. Ogston and Moore, analytical chemists of London, who, reporting on samples drawn from a large shipment of juice, said: 'we do not think concentrated lime juice can be better made.'

As to the resulting increase in the market value of the product, I am not yet in a position to speak from personal knowledge, as all my juice has been supplied to contract at a fixed price. Messrs. Scrutton, Sons & Co., however, replying to a query on the subject, wrote: 'There can be no doubt that it pays to be careful with your concentration. Of this fact we have had proof during the past season, as we have been able to obtain 30s. per hhd. more for juice which was thin and clear, and which contained less than 115 oz. of citric acid per gallon.'

Dr. Watts has repeatedly drawn the attention of planters to the great loss of acid resulting from excessive concentration, and the above quotation further emphasizes the advantage of boiling to only a moderate density.

I may remark that an increase in price of 30s. is equal to a net gain of over 28s. after deducting discount and charges, based on the value of the product.

COTTON INDUSTRY.

RECENT RESULTS IN THE CULTIVATION OF COTTON AT BARBADOS.

BY J. R. BOVELL, F.L.S., F.C.S.,

Agricultural Superintendent, Barbados.

At the last Conference, I made a statement with regard to the cotton industry at Barbados, relative to the best time to plant the seed, the cost of growing the cotton, and the profit to be derived therefrom, etc., I now propose, after further experience in the cultivation of this crop, to supplement that information.

With regard to the time at which cotton should be planted at Barbados, it is not yet possible to say definitely which is the best month, but judging from the results so far obtained, it would appear that from the beginning of July to the middle of August would be the best time for the seed to be sown in the black-soil districts, which are the lower levels of the island. In the red-soil districts, in the centre of the island, which are at a higher elevation, it would perhaps be better to plant a little later, probably from about the beginning of August to the middle of September.

Owing to the rapid increase of the cotton industry in Barbados, it was deemed desirable in 1905 to institute a series of manurial experiments to ascertain the requirements of the Sea Island cotton plant under the soil and climatic conditions which exist in the cotton-growing districts of the island. The experiments, which were started during the cotton season of 1905 have been continued this year, but up to this time they are not yet complete. Consequently, I am unable to present to you the results for 1906. The objects of the experiments are to ascertain (1) the quantity of nitrogen needed to produce the best results when combined with sufficient phosphoric acid and potash to enable that constituent to exercise its full effects; (2) to ascertain in like manner the requirements of the cotton plant with regard to phosphoric acid when combined with sufficient nitrogen and potash; and (3) its requirements as regards potash when combined with nitrogen and phosphoric acid.

The experiments for 1905 were conducted on two estates. On one estate, unfortunately, however, owing to an attack of the black scale (*Lecanium nigrum*), the results could not be taken into consideration. At Bentley plantation, the estate for which the results are given, the cotton was planted on August 7, 1905. The chemical manure was applied on August 24 and 25. The first picking was commenced on December 30, 1905 and finished on March 1, 1906. The second picking was commenced on May 1 and finished on May 25, 1906.

The cotton germinated regularly; the weather conditions during its growth were favourable, and the plants were kept

free from caterpillars and were well cared. The seed-cotton was valued at 7c. per lb.

The plots were divided into four series:—

1. No manure.
2. Nitrogen series.
3. Phosphate series.
4. Potash series.

In the nitrogen series, each plot received 60 lb. phosphoric acid as superphosphate, and 20 lb. potash as sulphate of potash. One plot received nothing further, but the other three received in addition 10, 20, and 30 lb. of nitrogen, respectively.

In the phosphate series, each plot received 20 lb. nitrogen as sulphate of ammonia, and 20 lb. potash as sulphate of potash. One plot received nothing further. The other four plots received 20, 30, 60, and 80 lb. phosphoric acid as superphosphate, respectively.

In the potash series, each plot received 20 lb. nitrogen as sulphate of ammonia, and 60 lb. of phosphoric acid as superphosphate. One plot received nothing further. The other three plots received 10, 20, and 30 lb. potash as sulphate of potash, respectively.

In the nitrogen series, there was a proportionate increase from the addition of nitrogen. The best result was obtained where 30 lb. nitrogen as sulphate of ammonia were applied per acre, the increased yield amounting to 279 lb. of seed-cotton. After deducting the cost of the manure, the profit over the no-nitrogen plot was $9·36 per acre.

In the phosphoric acid series, the best results were obtained where 40 lb. of phosphoric acid as superphosphate were applied. The increase due to manuring was 281 lb. of seed-cotton. After deducting the value of the manure, the profit by manuring over the no-phosphate plot was $14·87 per acre.

In the potash series, the best results were obtained where 20 lb. potash as sulphate of potash were applied. The increase due to manuring was 196 lb. of seed-cotton ; and after deducting the cost of the manure, the profit by manuring over the no-potash plot was $1·77 per acre.

In addition to the manurial experiments, experiments were carried out last year with regard to the selection of cotton seed. These are being continued this year. This is a matter of I might almost say, vital importance to cotton growers in the West Indies. In South Carolina, where the Sea Island cotton industry has been brought to such a state of perfection, it is a matter to which great attention is paid, as it is found that unless seed selection is carried on continuously, the yield and quality of the lint, quickly deteriorate.

As a detailed account of the method adopted for carrying out the seed selection has already been published in the *West Indian Bulletin*, (Vol. VII., p.p. 153-70) by Mr. T. Thornton, Travelling Inspector in connexion with Cotton Investigations, there is no need to describe it here.

Last year experiments were carried out at seven estates and 264 plants were selected in the fields. Of these, fourteen only were satisfactory in all their characters. The seeds from some of these plants have been sown and the lint obtained from such plants as have reached maturity is of much better quality than the average cotton grown in Barbados. This year the number of estates on which seed selection is being carried out has been increased to twelve, and an effort will be made to induce cotton growers to learn the method and to carry it out for themselves.

In addition to the experiments already mentioned, experiments have also been conducted at Barbados with four different insecticides (viz., Paris green, London purple, green arsenoid and Scheeles green), different fungicides (viz., sulphur and lime, and dry Bordeaux mixture and lime), and different methods for disinfecting seed before planting, and it is hoped that before long the results of these experiments will be laid before cotton growers.

The principal reason for growing cotton is the profit to be derived therefrom, and any reliable information on this subject will be of value to those who propose to undertake the cultivation of this crop.

Lately, the proprietor of estates in a district suitable for cotton growing, has furnished me with a statement, showing the results of his cotton cultivation at one estate for the three seasons 1903-6 inclusive, and at another estate for the season 1905-6.

As will be seen from the statement the average results at one estate for the three seasons were :—

Average area planted in cotton	53 acres.
„ quantity seed-cotton per acre ...	1,034·3 ℔.
„ „ lint per acre	297·3 „
„ „ seed per acre	720·3 „
„ net amount obtained for lint after deducting cost of ginning, shipping, the selling expenses in England, etc.	26c. per ℔.

EXPENSES.

Average expenses per acre for agricultural labour	$ 18·99
„ „ „ „ „ manure	7·74
„ „ „ „ „ salaries	2·49
„ „ „ „ „ taxes and insurance	2·37
„ „ „ „ „ tradesmen	1·58
„ „ „ „ „ repairs to buildings etc., for bags for cotton, Paris green etc. ...	2·53
„ „ „ „ „ upkeep of stock, freight, charges, etc., ...	3·49
„ „ „ „ „ sundries	1·53
Total average cost per acre ... (£8 9s. 8d.)	$ 40·72

The average clearance per acre including the value of the seed, after paying all expenses, was $47·48 or £9 17s. 10d.

At the second-mentioned estate, cotton has only been planted one year and the results, while they are very satisfactory, are not so valuable as those given above. From 17 acres for the season 1905-6, the average yield was 1,264 lb. of seed-cotton, which gave 352 lb. of lint and 898 lb. of seed. The receipts for the lint and seed were $110·54 per acre, the expenditure $42·50, leaving a profit of $68·04 per acre, or £14 3*s*. 6*d*.

These are sugar estates, and the amount paid in salaries, taxes, insurance, tradesmen, repairs, freight, etc., are calculated in proportion to the area of cotton, sugar-cane, etc., respectively. This statement may therefore be taken as the average cost of growing cotton in Barbados in a suitable locality. The average cost on the two estates of growing 1 lb. of seed-cotton was, at the first, 3·9c., and at second 3·3c. At the former, the value of the seed-cotton per acre was $88·20, and at the latter, $110·54. The seed has been valued at $24·00 per ton, the price which whole seed has realized in Barbados as food for estate animals.

The attorneys of a plantation in the parish of Christ Church, and the proprietor of another in St. Philip have also been good enough to furnish me with statements showing the results of their cotton cultivation at their respective plantations for the season 1905-6.

The average results at the plantation in Christ Church are as follows:—

Area planted in cotton	16 acres.
Average quantity of seed cotton per acre ...	926·7 lb.
„ „ „ lint per acre	263·6 „
„ „ „ seed „ „	651·9 „
„ net amount obtained for lint after cost of ginning, shipping, and the selling expenses in England being deducted	27·3c. per lb.

EXPENSES.

Average expenses for agricultural labour per acre	$ 16·27
„ „ „ manure per acre	7·20
„ „ „ salaries „ „	4·42
„ „ „ taxes and insurance per acre	1·75
„ „ „ repairs, bags, Paris green, etc.	1·125
„ „ „ upkeep of stock, freight, etc.	1·39
„ „ „ miscellaneous, staff etc. ...	1·435
Total average cost per acre (£6 19*s*. 11½*d*.)	$ 33·59

Average profit per acre including value of seed $45·35, or £9 8*s*. 11½*d*.

The average results of the plantation in St. Philip are as follows:—

Area planted in cotton	34 acres.
Average quantity of seed-cotton per acre	979·1 lb.
„ „ „ lint per acre	276·8 „
„ „ „ seed „ „	688·7 „
„ net amount obtained for lint after deducting cost of ginning, shipping, and the selling expenses in England	27·7c. per lb.

EXPENSES.

Average expenses per acre for agricultural labour	$13·09
„ „ „ „ „ manure	6·69
„ „ „ „ „ salaries	3·86
„ „ „ „ „ taxes and insurance ...	1·36
„ „ „ „ „ live stock	·335
„ „ „ „ „ Paris green	2·46
„ „ „ „ „ food for stock	1·05
„ „ „ „ „ miscellaneous	1·53
„ „ „ „ „ ginning, baling and shipping lint, and expenses in England ...	·412
Total average cost per acre	$34·49

RECEIPTS.

		£	s.	d.
Amount realized for lint ...	$2,747·10 =	572	6	2
Value of seed, 23,415 lb. at £5 per ton	$250·88 =	52	5	4
	$2,997·98	£624	11	7
Less expenses	1,172·69	244	6	2½
Amount cleared on 34 acres ...	1,825·29	380	5	4½
Average clearance per acre ...	53·68	11	3	8

Although I have been able to show very satisfactory returns from cotton growing at Barbados for the past three years, yet the cotton growers have their troubles, and this year, owing to the excessive rainfall at one time and the drought at another, the returns will be considerably less than they were last year, and unless some of the growers obtain heavy yields from their second picking, they will sustain a loss on the year's working. On one estate which gave a yield of over 1,200 lb. of seed-cotton per acre last year, the yield for the first picking this year will not be 20 lb. of seed-cotton per acre; and although there is no doubt but that cotton can be grown in Barbados, the prices will have to be on the average of those obtained for the past three years, if the industry is to be continued.

As it may not be without interest, the area of cotton planted, the quantity of lint shipped, and the yield of lint per

acre at Barbados for the three years 1902-5 inclusive are given in Table I. From this it will be seen that in 1902 there were 16 acres planted in cotton; in 1903, 800 acres; in 1904, 1,647, and in 1905, 2,000 acres. In Table II, the average prices for the same three years for first-quality Sea Island lint, second-quality Sea Island lint, Egyptian, Upland, Peruvian, and natize cotton are shown.

I may further state that the area estimated as planted in cotton in 1906 was 5,000 acres. Unfortunately, however, as stated above, owing to very unpropitious weather, the yield will not be as good as it has been for the past three years.

TABLE I.

Showing the area of cotton planted, quantity of lint shipped, and yield of lint per acre for the island of Barbados from 1902-5 inclusive.

Years	Area planted.	When shipped.	Amount shipped. Pounds.	Yield per acre. Pounds.
1902	16	to 30th Sept. 1903	5,400	337·50
1903	800	1st Oct. '03 to 30th Sept. 1904	187,945	234·93
1904	1,647	1st Oct. '04 to 30th Sept. 1905	279,264	169·53
1905	2,000	1st Oct. '05 to 30th Sept. 1906	479,418	239·71

TABLE II.

Summary of prices of Sea Island and other cotton shipped for the years 1904, 1905, and 1906.

Years.	1st Quality Sea Island.	2nd Quality Sea Island.	Egyptian.	Upland.	Peruvian.	Native.
	d.	*d.*	*d.*	*d.*	*d.*	*d.*
1904	15·48	...	7·38	6·14	8·00	8·25
1905	14·55	6·19	6·90	5·00	...	...
1906	15·20	6·06	...	...	...	...
Average	15·08	6·12	6·69	5·57	8·09	8·25

COTTON INDUSTRY IN THE LEEWARD ISLANDS.

BY THE HON. FRANCIS WATTS, C.M.G., D.Sc., F.I.C., F.C.S.,

Government Analytical Chemist and Superintendent of Agriculture for the Leeward Islands.

In a previous number of the *West Indian Bulletin* (Vol. VII, p. 30) early in 1906, I put forward a statement tracing the growth of the cotton industry in the Leeward Islands from very small experimental beginnings in 1900 up to a substantial industry in 1905, when some 383,000 ℔. of cotton lint were exported from the colony, of a value of approximately £22,300, exclusive of the value of the cotton seed incidentally produced.

As was intimated in that paper, it was expected that the industry would expand still further in the following year. This expectation was warranted, for the records for 1906 show that the exports of cotton lint were 526,382 ℔. of the value of £30,700—an increase of over 37 per cent. in one season.

The exports from the various islands of the colony during the two years have been as follows :—

	Pounds lint 1905.*	Pounds lint 1906.
Antigua, including Barbuda	54,289	99,948
St. Kitt's	78,219	120,379
Nevis	144,721	120,168
Anguilla	31,452	80,650
Montserrat	70,723	98,262
Virgin Islands	4,100	6,975
Total, Leeward Islands ...	383,477	526,382

These figures show very substantial increases in the case of each of the islands, except Nevis, where, owing to drought, the output has been smaller from an increased acreage than in the previous year.

I am not aware that any new pests or diseases have made their appearance in the cotton fields of the Leeward Islands during the past two years, though a good deal of trouble has been experienced from some of the old ones, such as caterpillars and leaf-blister mite. Constant vigilance and vigorous efforts are therefore necessary ; the destruction of 'old' cotton should

* These figures differ slightly from those in the *West Indian Bulletin* (Vol. VII, p. 30), having been compiled from amended returns.

be insisted on as a means of preventing the carrying over of pests from one season to another, and from one crop to another. The disease known as 'black boll,' which was formerly troublesome in some districts, particularly in Montserrat, has been less prevalent. The cotton boll worm (*Heliothis armiger*) has been found as a pest on cotton, first at Barbuda, and subsequently at Antigua; this is probably not a newly introduced pest but one which has been here for some long time. It was known as attacking corn (maize), but now seems to have turned its attention to cotton.

It may now be useful to state the condition of the industry in the various individual islands and to point out the directions in which progress has been made.

ANTIGUA.

During the season 1906, cotton growing at Antigua was undertaken on more systematic lines than formerly; considerable attention was given to the question of seed, care being taken to secure good qualities. Active efforts were also made to combat diseases, though here, as elsewhere, there is room for improvement. Caterpillars gave an unusual amount of trouble in the autumn of 1906, and very vigorous measures were required to keep them in check.

It is satisfactory to remark that the quality of the cotton produced at Antigua during the last year or two has undergone considerable improvement, so that now both brokers and spinners speak very favourably of it. This small measure of success should not lead to the relaxation of efforts to improve the quality of the cotton still further. Indifference in this direction is sure to lead to deterioration and disaster; indeed I feel that the danger of deterioration in quality is one of the greatest, if not *the* greatest, of the dangers we have to encounter in the future.

The area under cultivation was increased and, in most instances, the work was carried out on better lines, for it has begun to be recognized that cotton will form a useful rotation crop on sugar estates. Considerable development took place in the English Harbour district where a number of small holders planted cotton on land which for many years had been thrown out of cultivation, and a considerable quantity was planted, in this district, on Dimsdale estate, as an adjunct to the lime cultivation. In this way some measure of prosperity has been restored to a district which formerly was poverty-stricken.

The soil in the district around English Harbour is very well suited for cotton growing, the land is, therefore, being rapidly taken up for the purpose. A considerable tract belonging to the Government has been leased and a fair area planted in cotton. This promises well, and picking operations are now (January 1907) in progress.

In other districts considerable areas of land which have been thrown out of cultivation for years, have been cleared and planted with cotton. Several new-comers have arrived in the island with the intention of growing cotton; some of

whom have already acquired land and have cotton crops established. There is still a considerable area of land not under cultivation suitable for cotton growing, so that further progress may be looked for, and it appears certain that there will be a large increase in the quantity of cotton produced on the sugar estates.

The whole of the crop was ginned at the ginnery owned by the Government and worked by the Department of Agriculture. This has now been taken over by a company which has been formed from amongst local people interested in cotton. Two other ginneries are also being erected.

ST. KITT'S-NEVIS.

Much progress can also be recorded from St. Kitt's. Here it has been found that cotton can be successfully grown in the cane fields as an interim or 'catch' crop. It requires to be planted early—May or June—and must be removed from the fields by December or January. The canes are planted through the cotton about the months of November or December. With careful working, it would appear that neither cane nor cotton suffers from this method of cultivation, and greatly increases the material and financial productiveness of the estates. This affords an additional tribute to the ease of manipulation and the fertility of the St. Kitt's soil.

The ginnery erected at Sandy Point was not found to be necessary. Its working has been discontinued and the machinery disposed of. Some improvements have been effected in the ginneries for the crop of 1906-7. An additional gin has been placed in the ginnery at Spooner's, which is now equipped with three gins, steam baling-press, and a disintegrator for crushing seed. This ginnery can handle some 1,600 lb. of lint a day. An oil engine is to be erected at the Stone Fort ginnery in place of the aermotor formerly used. A small ginnery has been erected in Basseterre by Mrs. Pistana.

The crop now being picked promises well. The gale of September 1 blew the cotton bushes about considerably and it was feared that a good deal of damage would result, but, fortunately, the bushes have recovered in a satisfactory manner, so that, in most cases, little real loss has resulted. Caterpillars were extremely troublesome and required strenuous efforts to keep them under control. Leaf-blister mite was also in evidence, but the system of cultivation followed in St. Kitt's would appear to keep it in check, for the early destruction of the cotton bushes and the alternation with cane tend to prevent its spread.

The crop reaped in Nevis in 1906 was a comparatively small one for the area planted. The southern portion of the island suffered so severely from drought that in many instances the cotton crop was almost a total failure. Unfortunately, the conditions have been somewhat unpropitious for the crop now being picked, and it is feared that the crop of 1907 will be smaller than was anticipated. Dry weather led to late planting. This was followed by abnormally heavy rains in September, which unfavourably affected the cotton. Exceedingly high winds in September, at the close of the year, wrought further mischief,

A good deal of trouble was experienced with caterpillars and other pests; in order to minimise the difficulties thus occasioned, a temporary 'Cotton Instructor' has been sent to the island by the Imperial Department of Agriculture. Much benefit appears to have resulted from his work.

Some changes have been effected in the ginneries. An aermotor has been erected to displace the horse-gear at Richmond Lodge, a ginnery with two gins driven by an oil engine has been erected in Charlestown by Mr. Huggins, and a ginnery, also driven by an oil engine, has been erected at Indian Castle by Mr. Knight. I am informed that a company has been formed to erect a large ginnery, together with an oil-mill for the production of oil from the cotton seed. This is now in course of erection in Charlestown, and efforts are being made to have the machinery in working order early in 1907.

ANGUILLA.

Very considerable progress is to be reported from Anguilla. The shipments for the crop of 1906 amounted to 80,650 lb., of a value of approximately £4,600, without taking into account the value of the seed. This may be taken at some £400 additional. The area from which the present crop is being picked is considerably greater than that under cultivation for the crop of 1906, and it is expected that the exports will be very largely increased.

The conditions under which cotton is grown in Anguilla are described by Mr. C. Rey in the Report of the Botanic Station of St. Kitt's-Nevis for 1905-6.

It is worth noting that the conditions of life have been entirely changed at Anguilla by the successful development of the cotton industry. Formerly, there was scarcely an established industry; land had but little value, and a struggling population obtained a difficult livelihood by the cultivation of small quantities of ground provisions and the raising of a small amount of stock. This has now given place to considerable activity, and an organized and profitable industry.

MONTSERRAT.

Activity in connexion with cotton growing has been well sustained at Montserrat. The industry now ranks second in importance to the lime industry, and is of greater importance than sugar, which was formerly the principal crop. The cotton crop of 1906 exceeded that of 1905 by 27,500 lb., and still further increased production is looked for in connexion with the crop now being reaped. The industry may be regarded as thoroughly well established in this island.

A small ginnery was erected in the southern district of the island during last season, by the Montserrat Company, Limited. This company has just erected another ginnery near Richmond. This ginnery will first be used in dealing with the crop of 1907. The large ginnery at Dagenham, belonging to Messrs. Sendall & Wade is still operating and is capable of dealing with large crops of cotton.

SEA ISLAND COTTON CULTIVATION AT ST. VINCENT.

BY W. N. SANDS,

Agricultural Superintendent, St. Vincent.

At the last West Indian Agricultural Conference, held at Trinidad in January 1905, I submitted notes on the Cotton Industry of St. Vincent. It was mentioned that the cultivation of Sea Island cotton was started in 1903 as a result of the experiments and recommendations of the Imperial Department of Agriculture, and that a large Central Cotton Ginnery, which cost upwards of £2,000, was erected during that year. It was further added that the prospects of the industry were of a satisfactory nature.

Since 1903, the production of Sea Island cotton has increased from year to year. Cotton now takes the second place in point of value of the island's exports, and the industry is firmly established.

The following table, compiled from Customs returns, shows the progressive increase, both in quantity and value, of cotton exported during the last four years :—

COTTON EXPORTS, ST. VINCENT, 1902-6.

Year.	Sea Island cotton exported.	Estimated value.	Total amount of cotton exported (Sea Island and Marie Galante).	Total estimated value.
1902.	nil.	...	54,016 lb.	£ 475
1903 (Jan.-Mar.)	nil.	...	1,652 „	9
1903-4	not known	not known	43,392 „	794
1904-5	77,814 lb.	£3,890	126,178 „	4,494
1905-6	121,174 „	6,059	138,150 „	7,674
Total	198,988 lb.	£9,949	225,238 lb.	£13,446

It will be noticed that the cotton exported in 1902, was valued at £475 only, whereas in 1905-6, the value of the exports was £7,674, to which may be added the value (£606) of the cotton seed shipped, making the value of the industry to the island, during that year, stand at £8,280. This year, 1906-7, a further satisfactory increase in quantity and value of exports

will be shown, as a larger acreage has been put in cultivation, and is giving a fair return. Already the total amount of Sea Island cotton ginned is in excess of any previous year.*

The average prices obtained during the last three years are as follows:—

PRICES OF SEA ISLAND COTTON FROM ST. VINCENT.

Year.	Average price
1903-4	14*d.*
1904-5	16*d.*
1905-6	18*d.*

This is again a very satisfactory record, and it should be mentioned here, that a considerable portion of the 1905-6 crop sold at 20*d.* per ℔. Samples of the present crop have been valued 2*s.* per ℔, and it is expected that owing, to the firm state of the market, a higher price than this will most likely be obtained.†

I now propose giving a few points in connexion with the cultivation of Sea Island cotton in the island.

The soil is of volcanic origin and is very light. The rainfall is heavy, and nearly all the cotton is grown on lands where the average annual rainfall ranges from 80 to 120 inches, so that cotton could not be successfully grown with this rainfall if the land was at all heavy. As it is, the yield is not as high as in other islands where the rainfall is much less.

The average yield of lint per acre is from 175 to 200 ℔ in suitable localities, but this yield will be increased when a system of wider planting, and more intensive cultivation is generally practised. On one large estate last season where 225 acres were planted, the average yield was 211 ℔. of lint per acre, and one or two small growers obtained over a bale (360 ℔). Although, as mentioned above, the yield at the present time is not high, the high price obtained for the lint makes the industry the most remunerative one the island possesses at the present time. The outlook for the future is also bright, for it has recently been stated by Messrs. Oliver and Hutton of the British Cotton-growing Association, that with even a greatly increased output—(2,000 bales)—the lint would always sell at

* About 750 bales of Sea Island cotton, of an estimated value of about £30,000, were ginned at the Central Cotton Factory, St. Vincent, in 1906-7, or about an average of 180 ℔. (half a bale) to the acre. (See *Agricultural News*, Vol. VI, p. 172)

†Some St Vincent cotton has fetched as much as 30*d.* per ℔. during the 1906-7 crop. [Ed. *W.I.B.*]

a high figure, as it possesses characteristics such as lustre, and fineness, which cannot be beaten.*

In order to keep up the quality of the lint, the officers of the Imperial Department of Agriculture have this season started cotton plant selection experiments on a number of estates throughout the island, following the lines already described in the various publications of the Department.† These experiments will be carried on each season, so that only seed from specially selected plants will eventually be sown.

I have, so far, not been able to obtain statistics as to the cost of production of cotton in the island, for various reasons, but when the industry is well organized, and matters in connexion with the labour supply are adjusted, I estimate that with a yield of 200 lb. of lint per acre, the total cost per pound of lint will be about 10*d.*

The chief diseases attacking cotton here, are the leaf-blister mite, and the fungus causing 'anthracnose.' The leaf-blister mite is found in nearly all cultivations; it attacks the second growths chiefly, so that only small second pickings are usually obtained. Anthracnose is very prevalent as a rule, and a system of wider planting has been strongly advocated to allow the plants more light and air so as to reduce the amount of damage done by this disease. The cotton worm, although seen in small numbers last season has not yet caused any trouble. Its natural enemies, such as the 'Jack Spaniard' (*Polistes* sp.) have been able to keep it under control; nevertheless, all planters have been put on their guard, and asked to report immediately an attack to the Agricultural Department, who would advise as to remedies.

The area put in cultivation this season is 1,535 acres as against 790 acres last year, but about 100 acres of this total, planted in the area devasted by the eruptions of the Soufrière in 1902-3, have not done at all well. A good deal however was planted as an experiment, to ascertain if lands with a large proportion of ash, could grow cotton. This seasons' experiment would tend to show that these lands will not give, at the present time, very satisfactory results, and that a lot of reclamation work will have to be undertaken before cotton can be successfully produced. Arrangements are being made, however, for other experiment plots of cotton to be grown, and in the near future it will be definitely ascertained whether this crop is suited for this district.

There is still a large area of land in different parts of the island where cotton can be grown, provided there is labour available for picking.

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*The measurable qualities of St. Vincent cotton have recently been submitted to an exhaustive examination by the Travelling Inspector in connexion with Cotton Investigations, and compared with samples of cotton from other West India Islands. From a comparison of figures obtained in the cotton seed selection experiments, it would appear that St. Vincent cotton possesses, in addition to lustre and fineness, a very small proportion of weak fibre. Strong cotton is always wanted by spinners, and therefore it is probable that the strength of the St. Vincent produce has gone far towards gaining its high repute on the English Market. [Ed. *W.I.B.*]

† *West Indian Bulletin*, Vol. VII, pp. 153-70.

In this connexion, it might be mentioned that the peasantry are now taking to the industry, and although some trouble was met with labour last season, this year with nearly double the acreage in cultivation, fewer difficulties have been experienced. This season also, the peasantry themselves have put in a considerable acreage—about 170 acres—and an increased area will no doubt be put in for next year's crop. The Government by offering prizes to allottees on the land settlement estates for the best cotton cultivations has done much to encourage cotton growing among the lower classes.

The central cotton factory, mentioned at the commencement of this paper, has been worked under the control of the Imperial Department of Agriculture to date. The factory has proved a great boon to cotton growers, as they have been spared the trouble and expense of erecting buildings and machinery for the ginning and baling of their own cotton. Practically all the cotton grown has been dealt with at the factory, and the quality of the work performed has been highly commended by competent authorities. The price charged for ginning and baling is at the rate of 1*d.* per ℔. of lint, and at this rate a fair profit has been made each season.

The industry may now be said to be permanently established, and, therefore it is proposed to form a local co-operative company to take over the factory from the Government before the next ginning season.

The successful and timely establishment of the Sea Island cotton industry, due to the efforts of the Imperial Department of Agriculture, has been the means of greatly helping St. Vincent to tide over a period of extreme depression that has followed the disastrous hurricane of 1898, and the eruptions of the Soufrière in 1902-3—disasters which were accentuated by the fact that unremunerative prices were being obtained for the island's staple products of arrowroot and sugar.

RICE INDUSTRY.

Rice is successfully grown in British Guiana, Trinidad, Jamaica, and St. Lucia. In the last island little progress has been made, but the extension of rice growing in British Guiana in recent years has been of a phenomenal character. The success of rice growing in British Guiana not unnaturally suggests that a similar industry might receive encouragement in the neighbouring colony of Trinidad where about two-fifths of the total population is composed of East Indian or coolie immigrants, and where large quantities of imported rice are consumed.

There is also a certain number of coolie immigrants in the island of Jamaica, and it is possible that the cultivation of rice in certain districts in St. Elizabeth and Westmorland would be likely to prove a remunerative and successful industry.

The following details of the cultivation of rice in British Guiana should therefore be of particular interest.

EXPERIMENTAL RICE CULTIVATION IN BRITISH GUIANA.

BY THE HON. B. HOWELL JONES,

Delegate from the Board of Agriculture, British Guiana

In the report of the Botanic Gardens 1902-3, it will be seen that the Board of Agriculture reclaimed 3 acres of land on the north section of the Botanic Gardens and experimented with fifteen varieties of Indian rice which the late Hon. A. H. Ashmore had obtained from Ceylon. This was the first attempt with these experiments made at the Gardens. The report states further that the introduced varieties were not to be compared in quality with the best grown creole rice. The only sample that can be said to have proved worthy of attention is No. 2.

This was the beginning of our experiments with rice in these Gardens and since then, through the unabated interest of Prof. J. B. Harrison in agricultural matters generally, we have now extended our rice area threefold and over, and the varieties under cultivation have been multiplied fourfold.

At the request of Sir Daniel Morris, with the consent of the Acting Director of Science and Agriculture (Mr. E. W. F. English, M.A.) I have brought with me thirty samples of some of the more promising of these varieties, as they have been tested and their relative value ascertained in comparison with the creole variety which is taken as the standard.

During the year, experiments were conducted with seventy-nine varieties, and half of these were tested for the first time.

They were obtained from various sources. Compared with the creole variety, six of these gave higher yields.

A list of the best of these rices is published immediately after the crop is reaped, giving periods of growth, yields in bags of paddy per acre, and their milling qualities when possible. By his Excellency the Governor's permission, the paddy is distributed to bona fide rice planters, they paying the cost of packing and transportation. I think it will be seen from the above, that a good deal of assistance is given to rice cultivation. No fewer than about 500 gallons were distributed free during the past year, and 600 gallons are available for distribution during this year.

The coast lands of British Guiana are more or less ideal places for rice cultivation but a proper system of irrigation is necessary in some places: this can however largely be overcome, if regard is paid to the season for planting and the varieties of rice to be handled. For instance, the ordinary creole variety—which is so far principally grown throughout the colony, takes practically six months to mature. In short dry seasons, where a good system of irrigation is not in vogue, and the time for planting out not carefully adhered to, failure will accrue for lack of sufficient moisture. On the other hand, if late planting is resorted to, especially in districts where the lands are likely to be inundated from heavy rains and bad drainage, large quantities of the crops suffer in consequence. If early ripening varieties, like the Carolina Golden Grain, Honduras, Dwarf Japan, etc, are planted, the crops can be reaped one or two months earlier, but as the creole variety has had a good start on the newer ones, having been in cultivation for a number of years, mostly in the hands of the East Indians who have a fair knowledge of rice cultivation, it cannot be expected that the cultivators will at once turn their attention to the cultivation of new varieties, especially under favourable circumstances and seasons when they get very good returns from the creole rice.

From the collection of rice now exhibited, it will be observed that there is a considerable variation in the colour of the different varieties: those of lighter shades find the greatest favour with growers and buyers alike; whilst there is very little demand for the darker ones. The real reason for this I cannot tell for certain, but I believe it is because they command a better market.

The method of planting in the colony is first to sow the seeds in beds prepared beforehand, and when the seedlings are about five to six weeks old they are planted out in clusters of three or four plantlets, at about 9 to 12 inches apart, in fields previously ploughed. At the time of transplanting, however, the soil attaching to the roots of the seedlings is carefully washed away, and the heads of the seedlings pinched off. The fields are then supplied with a liberal quantity of water.

In connexion with our experiments here, we have not been able to put the 'hill' rice to a full test. Up to now it has had practically the same treatment as the others; but we hope,

as our area is extended, to be able to do some further experiments with this particular variety. It may be remarked, however, that from the results of two past years, when treated the same way as the ordinary kinds, this rice made excellent growth; but this year when a less quantity of water has been used; it has given a much heavier return.

The following extract, taken from the *Demerara Daily Chronicle*, of a speech delivered by the Hon. C. T. Cox, then Acting Governor, on the occasion of the opening of the Demerara County Agricultural Show in August 1906, gives a fair idea of the position which rice cultivation occupies among the minor industries of the colony: -

'No one who had seen them (the exhibits) would doubt that the minor industries had come to stay. The most important of these - the one which gave the greatest object-lesson--was, of course, the cultivation of rice; and if anyone fifteen years ago had ventured to prophesy that British Guiana would become a rice-producing country, he would probably have been laughed at. As a matter of fact, they exported last year over 29,000 of colony-grown rice to the neighbouring colonies, and the acreage under cultivation, speaking from memory, was 24,000 acres. During the current year, the acreage under cultivation would, he thought, amount to about 30,000 acres, and the value of the product, it was anticipated, would reach one million dollars.'

This gives a brief outline in regard to the rice industry in this colony, which would appear to be already assured of every success.

The Acting Governor's prediction that the quality and value of colony-grown rice during 1906 would reach 'high-water mark' was a safe one—for whereas the quantity of locally grown rice exported last year was 45,223 lb., this year—that is for nine months up to December 1906 - it has been 1,592,252 lb., value \$40,302; and the quantity held locally and consumed will account for the balance of the crop. The estimated crop of the colony, 1906, is 216,000 bags cleaned rice.* The prospects of the 1907 crop are bright; new lands are being taken up, and rice mills are being erected in all parts of the colony.

Note Added.

Returns made to the Board of Agriculture have shown that the acreage under rice had increased from about 6,000 acres in 1900 to about 24,000 acres in 1906. It is estimated that this year (1907) about 26,000 acres of rice will be under cultivation in British Guiana.

With the large increase in the production of locally grown rice, the imports are gradually, but steadily, decreasing. For instance, seven years ago (1899-1900) the imports of rice into British Guiana were a little over 25,000,000 lb., while last year (1906-7) they had fallen to a little over 6,000,000 lb., showing

that during a comparatively short period the imports had shrunk more than 75 per cent.

While British Guiana rice is being consumed locally, and is taking the place of imported rice, it is also being exported to the British West Indies, and to the French and Dutch Guianas. Rice was first exported from British Guiana in 1902-3 amounting to 10,506 lb., of the value of $290·04. In 1904-5 the exports reached 61,225 lb., of the value of $1,709·44; while in 1906-7 the increase was enormous, the exports amounting to 3,474,512 lb., of the value of $89,078·21 (£18,000.)

[Ed. *W.I.B.*]

RUBBER INDUSTRY.

RUBBER CULTIVATION IN JAMAICA.

BY THE HON. T. H. SHARP, Jamaica.

Now that rubber cultivation has been taken up seriously in Jamaica by several planters, I have compiled the following short notes with the view of rendering assistance to all intending planters.

There are so many varieties of rubber which appear in different countries to thrive best at various altitudes and to yield according to varied conditions, that it would appear to be impossible to lay down any fixed advice in the matter as to what we should do in Jamaica as to the choice of kinds for planting. It may be possible, however, by comparing results obtained in other countries, to be able to advance upon reasonably sure lines to suit our conditions.

For the present, planters should confine their operations as to laying out plantations to as few varieties as possible, but at the same time to experiment with as many other varieties as is convenient on a small scale. Such experiments should be laid out in different localities possessing varied soil and climatic conditions.

The plantations should be commenced with *Hevea brasiliensis*, *Castilloa elastica*, and *Forsteronia floribunda*. Other varieties might be tried, but it is probable that the abovementioned rubber-producing plants might be relied upon for cultivation in certain districts in Jamaica.

SOILS.

The lands of Jamaica may be divided into the following four classes :—

1. High altitude lands from 2,000 to 4,000 feet, mostly of limestone formation, covered with trees, rich in humus, naturally drained, with plentiful rainfall.

2. Lower altitude lands from 1,000 to 2,000 feet, good rainfall, generally rich, but now being more largely cultivated.

3. Lands from 400 to 1,000 feet in altitude, fairly well denuded of forest, severely injured by running fires, and populated more thickly than the higher lands. This section would possess but small areas that could be conveniently given up for rubber cultivation.

4. Lands extending from sea-level to 500 feet. The deepest and richest lands of the island, with well-defined seasons, rainfall less than the higher altitudes. This land, being deeper and richer, is more retentive of moisture.

Each altitude enjoys it peculiar advantages and varies as much in its class of labourer as it does in its soils and climate.

Any fixed advice as to the cultivation of rubber or of any other plant cannot, therefore, be given so as to apply to the whole island. It is only by comparisons and experiments that the best results can be obtained in each locality.

Unfortunately, rubber takes a long time to produce, and must be cultivated on a fairly large scale to ensure success. It is impossible, therefore, to commence experiments with rubber now, if we mean to keep pace with other parts of the world.

I can only in this short paper make a mental résumé of the valuable articles which have been written by the Director of Public Gardens and by the Secretary of the Agricultural Society, as well as by several authorities on rubber cultivation, and to embody their views and conclusions with the small experience with experiments I have carried on for the past year.

VARIETIES OF RUBBER.

Castilloa elastica, assuming that the correct variety is obtained and that seeds have been taken from latex-producing trees, can safely be planted in any district where the bread-fruit thrives.

This rubber-producing plant, it has been said, will die back when severely tapped if it is grown upon land unsuited to it. I am inclined to believe this, because it is such a luxuriant grower and is not as hardy as the Para rubber tree. I note that the Para stands transplanting much better than Castilloa; but, on the other hand, under favourable conditions, Castilloa will grow larger and yield considerable quantities of latex in a country that may be called its natural habitat. Plants scattered about in the bush several years ago and forgotten, have survived. To-day from one end of Jamaica to the other may be found some Castilloa trees that compare favourably with trees grown in any part of the world in respect to size and quality of latex.

The advantages that Hevea has over Castilloa in this country, is its hardiness, and its 'wound reponse' stimulating flow of latex in tapping. On the other hand, Castilloa, under favourable conditions, yields earlier, forms better shade for cacao, and eventually should give more latex per acre than Hevea. More care will have to be taken in the tapping and in the selection of the soil before planting.

In dry districts, Hevea would probably thrive better than Castilloa, for it is a very hardy plant.

The Ceara plant (*Manihot Glaziovii*) has been recommended as suitable to dry districts, but the difficulty in tapping, slow growth, small yield, and value of latex place it, to my mind, as being quite unfit for this island, where land abounds which can produce better varieties.

One of the serious points to be dealt with in the cultivation of these two varieties is the production of seedlings. From the time the seed germinates no check should be given to the plant, especially in the case of the Castilloa. In Jamaica, there is quite sufficient large healthy full-bearing milk-yielding Castilloa trees to furnish all the seedlings required. These trees drop their seed in July and August and it should be

gathered daily and planted out at once in boxes to germinate. Small boxes conveniently holding 100 plants each should be used. Bamboo pots although easily portable should not be used, as they cause the roots of the plant to grow unnaturally, and the plants are apt to sicken. Experiments this year showed that seeds planted in boxes produced larger plants than those grown in bamboo pots, in about half the time. The seeds from the same tree and the same earth were used in each case. Several of the seedlings grown in the bamboo pots became so sickly and weak that they had to be thrown away.

The best time for planting out Castilloa would appear to be after the first rain at the end of September or early part of October, and during the first and second week in April.

Castilloa seed is of such a perishable and soft nature, and the seedlings are so delicate, that it requires a good deal of skill and attention to preserve them in a healthy state ready for planting.

This perishable seed, produced in July and August, cannot be successfully grown to a sufficient size to plant out in the field by the end of September. A few of the earlier bearings will do so, but the bulk of the seedlings will not be strong enough in time for planting, and, consequently, will have to be kept back until April. They may become too large for the boxes and will therefore have to be transferred to beds in a nursery.

Hevea seed cannot be obtained in this country, and has to be imported. Under favourable conditions, if a planter tests his Hevea seed and finds that it germinates well, it would probably be advisable to put about three seeds directly into the earth where he intends to grow plants permanently. If they all grow the weakest should be removed and transplanted.

Castilloa should be planted on the group system 20 feet apart, three plants being put into each hole so as to ensure an establishment of absolute healthy trees. As soon as the plants have taken root, and have grown about 3 feet high, one plant should be removed, and at the end of four years the weakest of the remaining two might be so heavily tapped as to bleed it to death. This would give a small return and would ensure the permanent establishment of one healthy tree, and so far from retarding or injuring the tree would help it, as Castilloa appears to succeed very well in group planting provided it is given a fair area between each hole.

Hevea should be planted 20 feet apart, but not in the group system. It naturally grows straight, and therefore differs from Castilloa, which is inclined to throw out lateral branches before it reaches a good height.

Hevea should do best on alluvial lands, but I see no reason why it should not also thrive on any ordinary land that is sufficiently rich and has a fair rainfall.

With regard to the *Forsteronia floribunda*, we have in Jamaica a natural rubber-giving vine that abounds over almost all our limestone formations. It is a climber, and can be found plentifully at altitudes from 200 feet to 4,000 feet.

Hitherto the impression has been that the rubber from this vine was of inferior quality, and the vine could only be found here and there in isolated places. Investigations by officers of the Jamaica Agricultural Department have shown, beyond doubt, that this vine grows indigenously over many thousand acres of our land. It yields rubber of an exceedingly high quality that is free from resinous matters.

It trails along the ground for about 20 to 30 feet and then mounts the forest trees.

I have given this plant a good deal of attention, and have made and submitted its rubber to experts. They have pronounced it as being highly satisfactory.

Tho cultivation of this rubber-producing plant could be carried on very easily. Enter the bush and under-wood, gather your cuttings direct from the prosent growing plants, and place them into the ground in rings around standing trees. They will grow readily and run on the trees. The bleeding of them would be exceedingly simple. By cutting a small slice on the side of the vine by means of a sharp instrument, the milk would run readily into a pan placed beneath.

This vine grows readily on the kinds of land that are too rocky for either Hevea or Castilloa. It has been said that because the vine is a climber it would not lend itself readily to cultivation but it should be comparatively easy to establish, if these vines are planted 6 feet apart in the woods, from 1,000 to 1,200 vines per acre.

A single vine will often yield sufficient milk from a single tapping to give an ounce of rubber, and assuming you tap the vines several times in a year, the yield would be considerable. The collection of rubber from vines is now being carried out largely on a commercial scale in other parts of the world and there should be no reason why this rubber-producing plant could not be successfully cultivated for the same purpose. The demand for rubber is exceeding the natural supply. Cultivations are springing up on every side, and there are many parts of Jamaica that could be made to produce as good rubber as can be obtained from other parts of the world.

PROGRESS OF THE RUBBER INDUSTRY IN TRINIDAD.

BY J. H. HART, F.L.S.,

Superintendent, Royal Botanic Gardens, Trinidad.

At the West Indian Conference of 1901, I read a short paper on the experiments carried out by the Botanical Department, Trinidad, in connexion with the cultivation of various kinds of rubber trees. In that paper (published in the *West Indian Bulletin*, Vol. II, pp. 100-10), six different kinds were mentioned, viz.: *Castilloa*, *Hevea*, *Manihot*, *Ficus*, *Landolphia*, and *Funtumia*; to which was also added balata, (*Mimusops globosa*), a native tree affording produce similar to that of the gutta-perchas of the East.

CASTILLOA OR CENTRAL AMERICAN RUBBER.

Since 1901, Castilloa planting has been steadily continued in Trinidad, and some thirty-three estates are now engaged in the industry, the total number of trees planted being estimated at some 300,000. Numerous experiments have been made with a view to discovering suitable methods of tapping and preparing the latex, and the specimens secured afford reliable evidence of the success achieved.

It can now be recorded that the colony of Trinidad and Tobago has several plantations which, during the past year, marketed rubber of fine quality and obtained satisfactory prices. In recent account sales, 3*s.* 3*d.* was obtained for Scrap and 4*s.* 3*d.* for Castilloa Sheet rubber. The samples were identical with those presented at the Conference. In Tobago, fine rubber has been produced. Scrap realized 4*s.* per ℔. while prepared Sheet made 1*s.* to 1*s.* 3*d.* higher. The quality of this rubber may be judged from the produce kindly loaned by proprietors, now exhibited.

In Mr. de Verteuil's block rubber, we have a very fine specimen, and I should not be surprised to find rubber prepared by this method, taking a first place upon the market, it being apparently preferred to sheet, on account of its oxidizing less quickly.

The specimens of Castilloa prepared by the Experiment Station show the result of experiments in preparation.

The first was prepared by creaming in three waters, and then naturally coagulating by placing in blotting paper over a fine wire strainer.

In preparing the second specimen, the rubber latex was washed through a fine strainer with about eight volumes of water and then left for six days. The rubber naturally coagulated on the surface in a solid mass, and has since been pressed and dried.

The third specimen is the creamed latex of the first sample pressed between blotting paper, the fibre of which has

formed a coat upon the surface. This is seen to have preserved the specimen from oxidization, except in places where it is not covered with the paper fibre.

The rubber latex from which these specimens were prepared was produced by immature and undersized trees about eight and a half years old, which were cut out for thinning purposes. The rubber is not of first-class quality, but the specimen prepared *without washing*, appears to be the best and most elastic.

The 'Tortuga' sample is from trees some nineteen years old. The 'Louis D'Or' sample is from younger trees. The 'Richmond' sample is from trees some twelve to fourteen years old; the exact age of the trees is not stated but it is mentioned that 4 lb. of dry rubber is expected from one of the trees for the year 1906.

The 'Monte Christo' sample is from one of the first estates planted with this kind in Trinidad. The age of the trees which produced it is not stated by the proprietor but from certain facts known to me, I assume it to be nineteen years.

The 'Verdant Vale' sample is from young trees seven and a half years old. It appears that scrap rubber of the quality seen on the table is readily saleable, and as it costs less to prepare, it raises a question whether the price realized for sheet rubber is sufficient to cover the cost of extra preparation

The cost of preparation per lb. has been variously estimated. It would be unsatisfactory, however, to make a definite statement of the cost of tapping and preparation on the present evidence. One large grower states that he prepares his sheet rubber by indentured labour, at the rate of 15c. per lb. but whether this will prove generally above or below the average is still doubtful. In my estimates, I fix the cost of preparing sheet rubber at a somewhat higher rate. It is to be noted that West Indian labour has to be taught first, before it can be calculated upon.

The preparation of 'scrap' rubber would cost probably one-third less than 'sheet.'

Castilloa as a rubber has done well in all parts of Trinidad, and appears to suit the conditions of soil and climate.

The supply of seed is so plentiful that the sales made by the Department are now merely nominal. Moreover, by birds carrying off seed, the tree is being distributed widely through the natural forest, where it grows readily.

HEVEA, OR PARA RUBBER.

The progress made in Hevea planting has been much encouraged recently by the prices obtained for Ceylon produce. The demands upon our resources for seed and plants is now more than we can meet; hence, a considerable number of importations have been made with a success varying from 2 per cent. to 60 per cent. Various methods of packing have been tried.

From personal experience it appears better to take the chance of seed transport rather than to import plants, even in Wardian cases.

Some twelve years ago, I advocated strongly in the Trinidad *Bulletin*, the planting of Hevea. One planter planted a considerable number, and to-day, his trees are seeding freely and he is making an excellent return from seed and seedlings, and has thus provided for a future supply of home grown seed, which will probably meet future demands. The trees in the lands of the Botanical Department gave a fair supply of seeds, from which several thousands of healthy plants have been realized. All of these have been readily sold.

Eight or ten estates are now planting Hevea and this number will probably be doubled during the coming year.

With regard to the ability of Trinidad to produce first-class Para rubber I submit to the Conference specimens of various forms from the older trees of the Botanical Department. These specimens have been produced by two trees of the first consignments sent out by Kew over thirty years ago. The first tree gives rubber decidedly yellow in appearance, while the second tree gives rubber which on first coagulation is pure white, and probably differs considerably in composition from the first.

Two methods of collection have been adopted. The first is to collect all the latex possible and set it to coagulate naturally; the second is to roll up the remainder of the rubber which dries in the cuts, to a ball.

It is found that a second and even a third flow can be obtained from the same cuts, if the rubber is allowed to dry for some eighteen to twenty hours in the cut; for when it is removed a new flow takes place from those cells, which have been prevented from closing by the adhering rubber.

That the rubber is of good quality, is shown by the specimens now submitted for examination. The latex when set to coagulate is simply strained through fine wire gauze with a minimum of added water, and then left in a soup plate or glass cell in a cool place. Twelve to twenty-four hours afterwards there can be removed soft sheet rubber perfectly coagulated. It may then be pressed into biscuits, in a copying press or by other suitable means. Rubber thus treated will dry quicker than if left to drain by itself.

At the Experiment Station, Hevea trees eight and a half years old do not as yet yield rubber in quality or quantity to pay for tapping, although the trees are some 35 feet high with stems 6-9 inches in diameter. Our oldest tree has a diameter of 2 feet 3 inches at 4 feet from the ground, and gave a crop of over 4,000 seeds during the season 1906.

From our tapping experiments it may be estimated that 3 to 4 lb. of rubber could readily be taken from this tree, but, as it is depended upon for purposes of seed, it has been deemed better not to hazard productiveness by tapping too heavily.

Two young trees raised from seeds brought down by Dr. Bovallius, from the interior of South America are growing

slowly and appear to be somewhat different from the kind first introduced, but as they have not as yet flowered, it is impossible to decide their affinity. They are said to be suitable for growth at higher elevations or in cooler climates than the ordinary varieties of Hevea, but this remains to be proved. There is no doubt a great future for Hevea planting in Trinidad, the only drawback being the length of time the trees take to reach maturity. This state of maturity most assuredly will be fixed at different ages by individual growers, probably guaged by financial reasons.

Trees can be tapped at an age, when tapping is sure to injure them, therefore cropping must always be conducted with greatest care, as serious wounds must inevitably prove prejudicial to the life of the tree.

The question of the best method of tapping is well laid down in Wright's *Para Rubber**, but there is always the possibility that local circumstances will compel the adoption of methods differing slightly from those found successful in other countries. We see spiral cutting strongly recommended and illustrated, and have found it a successful method with trees growing strictly perpendicular, but it is evidently one which cannot be used with leaning trees.

MANIHOT, FICUS, AND LANDOLPHIA.

These three rubbers, at present, do not commend themselves to our cultivators for various reasons. *Manihot Glaziovii* has however, been tried on one or two estates, and one of these situated on a hillside, is reported as doing well. *Ficus elastica* grows readily and lasts for a long time, but is only cultivated as individual specimens. *Landolphia* spp. exist in the gardens, and one of them affords rubber of fair quality. These rubbers are not at present sought by planters.

LAGOS SILK RUBBER.

Funtumia elastica is being largely planted. Many thousands of seeds have been sold during the past year, and plants to the number of nearly 50,000 have been distributed, or stand to order from the nurseries at the Experiment Station. This tree affords rubber at an earlier age than any other rubbers.

Specimens of rubber taken from trees six and a half years old were reported upon by the Imperial Institute in 1903, when 80 per cent. of caoutchouc was found, and Professor Dunstan in his report† states that it would be desirable to examine specimens from older trees.

In 1903, this rubber compared with Castilloa from trees over twelve years old, was valued by London brokers at 2*d.* to 3*d.* less per lb. than Castilloa. We are not yet in possession of

* *Hevea brasiliensis* or Para Rubber by Herbert Wright, A.R.C.S., F.L.S. Colombo: Messrs. A. M. and J. Ferguson.

† *Bulletin of the Imperial Institute*, 1903, No. 1, pp. 160-7.

sufficient evidence to make a statement as to yield, but those persons who have seen it in its native forest consider the yield satisfactory.

BALATA.

Of balata (the produce of *Mimusops globosa*) there is little to report. The tree is indigenous to Trinidad and South America and produces fine timber for railway work. A considerable number of inquiries have been received for plants at the St. Clair nurseries, and plots have been started at St. Clair, and on the Government estate at Diego Martin, Trinidad, so as to have a convenient supply of seed on hand to meet future demands.

At present the forest has to be depended on for supplies.

Many applications have been received for seed from foreign and colonial establishments, which show that considerable interest is taken in this product.

Trinidad exports but little of the locally grown product, but considerable quantities are shipped from Venezuela, via Trinidad.

The tree is of slow growth and the seeds are difficult to transport. Even when fresh they take a long time to germinate, periods of twelve months having frequently been observed from the time of sowing to germination. In the St. Clair nurseries the germination is hastened by grinding or filing away the hard exterior of the seed to allow access of moisture.

CONCLUSION.

In conclusion, I am able to state that the rubber industry is now well established in Trinidad, and that there is a prospect of abundant success. The initial difficulties have been met and overcome, and it is probable that with further experience in the details of manipulation, greater economy and profit will follow.

Estates planted with rubber have largely increased in value, and planters are beginning to appreciate the feeling of adding to their established industries one that promises well for the future.

RUBBER IN BRITISH GUIANA.

BY THE HON. B. HOWELL JONES,

Delegate from the Board of Agriculture, British Guiana.

Recently the questions of collecting rubber in its wild state, and of its cultivation have been very prominently before the public of British Guiana. Applications have been made by several companies for grants of Crown lands for these purposes, and there is no doubt that British Guiana offers an excellent field for rubber cultivation, as there are large tracts of lands in the interior which are quite suitable for this kind of cultivation. With regard to the Heveas, I do not think very much is known, up to the present, as to the real number of these to be met with on our rivers and creeks. They are widely distributed throughout the interior and are found principally in low-lying swampy lands. There are several species found here especially in the Tapacooma, a tributary of the Pomeroon river, but these are nearly all weedy saplings. In Essequebo, Massaruni, and Demerara rivers they attain a fair size but do not seem to be of any great age. The species most commonly met with are *H. pauciflora* and *H. confusa.*

I am unable to give any information as to the yield per tree and the value of this rubber.

Rubber from Sapiums obtained in the North-West fetches 77c. per ℔. and has been already exported in fairly large quantities.

So far I do not know of any latex gathered from Heveas having been exported, but that they are found in fairly large quantities, 200 trees to the acre, I am prepared to vouch for. The cultivation of *Hevea brasiliensis* has been attracting the attention of some of our sugar-cane proprietors. Two or three have already imported several thousands of seeds from Ceylon. These I should say would stand more chance of success if they were planted on the low-lying swampy light lands of the interior than on the stiff, front lands of our sugar estates. Heveas require moist lands. *Sapium aucuparium* is found growing wild on some of the stiff lands along our coast, especially on the west coast of Berbice, so that this tree ought to have more chances of success on such lands than would the Heveas.

The next of importance as a rubber-producing plant that might be mentioned is *Castilloa elastica*—this ought to succeed on well-drained high-inland lands—but indigenous Sapiums or *Hevea brasiliensis* would prove a more profitable cultivation planted in favourable localities. There are now exhibited specimen plants of *Sapium Jenmani, Sapium aucuparium,* and *Sapium biglandulosum, Hevea pauciflora,* and *Hevea brasiliensis.*

Funtumia elastica grows readily here—but from what Mr. Johnson of the Gold Coast says of its yield, I do not think it would be a profitable tree to plant.

There are several species of indigenous rubbers growing here, prominent among which are the native species of *Sapium* which would probably thrive on the Coast lands.

For our present knowledge of these Sapiums found in the colony, I would refer those interested in them to a recent report by Mr. Edgar Beckett, Principal Instructor-in-Agriculture to the Board of Agriculture, on a visit paid by him to the North Western District during June, July, and August, 1906, to investigate and report to the Government concerning these native plants. I do not think that I could do better than quote the latter portion of this very interesting and valuable report:—

This expedition has settled the question as to whether there are very valuable rubber-producing trees in the colony. The answer is in the affirmative. There are several species of *Sapium* growing scattered here and there in our forest which yield an abundance of latex, forming good and valuable rubber. Another point of great importance which has been settled is, that Monsieur Henri Jumelle, Professor-Adjoint à la Faculte des Sciences, etc., etc.—an authority on rubber trees—is wrong when in his 'Plantes à caoutchouc' (page 15) he speaks of *Sapium Jenmani* as being spoilt by the quantity of resin contained in the latex, giving a useless product. This is not so—the *Sapium Jenmani* I found in the upper Pomeroon yields commercial rubber. It is evident that, either by aboriginals, or others, with the latex of this Sapium had been mixed the milk obtained from several of our native Ficus plants, such as 'Dukalliballi,' etc.

Now my experience was that these Ficus plants yielded no rubber at all, but only a poor quality resin, and, if mixed with the latex of any valuable rubber tree would naturally result in a useless product being obtained. These trees are much more easily found and would therefore be readily tapped by Indians and others for adulterating purposes.

Sapium aucuparium, one of the most valuable rubber trees in the world, I saw no signs of in the Waini, though there was another rubber-producing Sapium yielding a product fetching 3*s*. 10½*d*. per ℔.

As far as I remember, *Sapium aucuparium* is growing up the Aruka, a tributary of the Barima, which river I had no time to ascend, whilst on this expedition.

As I have said before, the Sapiums, according to my experience, grow wild, are scattered over very large areas, are giant forest trees, and in some cases yield most valuable rubber. If with the careless tapping methods of our aboriginals a product can be obtained fetching 3*s*. 10½*d*. per ℔. in the home market, it is quite certain that the trees with correct tapping and careful preparation of the latex, would yield rubber that would fetch a price of 25 per cent. higher.

The Indians all bleed very much too deeply, adding quantities of sap to the latex.

In the Tapacooma creek and tributaries of this creek are to be found several Hevea saplings. These, I believe, were well

known to Mr. Jenman, and are possibly *Hevea Spruceana* and *Hevea guianensis*. *Hevea confusa* also grows in our colony. I have never seen any *Hevea brasiliensis* (Para rubber of commerce) growing anywhere in British Guiana, except from imported seed. Nevertheless, *Sapium aucuparium* ought to be able to hold its own against *Hevea brasiliensis*, and the former tree is actually found in British Guiana and is being exploited up the Aruka river.

Personally, I believe that the only rubber trees of the colony worth consideration are certain species of the genus Sapium. This genus belongs to that large family of plants the *Euphorbiaceae* to which Hevea, Manihot, etc., also belong.

Sapiums are found in both hemispheres. M. Jumelle tells us, that *Sapium biglandulosum* is American, whilst *Sapium sebiferum* belongs to China and Japan, and *Sapium insigne* to India.

Sapiums are monoecious; leaves are alternate, with petioles; margin smooth, dentate, or serrated; and are furnished at the top of the petiole with two glands. Sometimes these can be just barely detected by the naked eye, whilst in other cases they are very long. In one case, as I have mentioned earlier in this report, I found a Sapium with these glands growing at the back of the leaf.

The inflorescence consists of a long spike with the flowers of both sexes—the male flowers occupying the upper part of the axis and are in groups of three or more in the axils of the bracts, the female flowers occupying the lower part and are detached.

The perianth of the male flowers has two lobes and the female three. The androcieum consists of two or three free stamens, the ovary is three-celled.

The fruit consists of non-fleshy seed-case (non-drupaceous capsule) and is very much smaller than that of the Hevea— so much so that many of the Indians think that it does not bear fruit at all. It opens in three divisions with a column in the middle. The seeds are generally slightly ovoid, biconvex, with a covering either smooth or rough.

Beyond *Sapium Jemani*, a specimen of which is growing in the upper avenue of the Botanic Gardens, not having seen either fruit or flowers of the others I found in the upper Waini and its tributary the Imoti, I am quite unable to say what species of Sapium they are.

Sapium biglandulosum grows commonly enough not only along the east coast of Demerara and the west coast of Berbice but also in Georgetown itself. Doubtless it is also to be found in several parts of the colony. At De Kinderen, Berbice, it grows on the front pasture lands somewhat freely. I did not see this species at all in the Waini, but, of course, with the short time at my disposal and the tremendous area of land to be covered, it does not by any means follow that it is not growing there too.

There are several specimens of *Sapium biglandulosum* growing in the bush behind the rice fields of the Botanic

Gardens, and the trees are found skirting the bank of the Lamaha Canal. Professor Harrison also found this species growing at Golden Ridge estate, Barbados.

Sapium aucuparium can readily be recognized by an aculeated gland growing at the extreme tip of the leaf. This species is found growing at De Kinderen, Berbice, Mahaicony, and other parts of the colony. It is supposed to be this species that a well-known gentleman in the north-west district has planted, to the number of 15,000 seedlings.

Other well-known trees are *Sapium acreum*, *S. verum*, and *S. stylare*.

Personally, I am of opinion that there are several varieties of these species and that though the species itself may produce caoutchouc, the variety may not.

As regards the correct methods of tapping, this depends entirely on the way the lactiferous vessels run. At present, I am not in a position to give any satisfactory suggestions on this point.

I am not of opinion that it would prove a commercial success for any one or any company to take up large areas of land to bleed Sapiums, unless—

1. The man in charge is well known to the aboriginals (on whom he has to depend if he wishes to find any trees), and has a considerable amount of personal influence with them.

2. Satisfactory personal evidence is forthcoming that the trees are known to be rubber-producing.

3. Some other industry is carried on at the same time and large quantities of the correct kind of young Sapium seedlings are planted, and that they be allowed ten years' growth before bleeding operations are commenced.

I would very respectfully sound a note of warning in connexion with the question of legislation. Though there must be every care taken against establishing a monoply, still if stringent regulations are made and enforced, now the industry is just in its infancy, there will be a considerable chance of its being strangled.

I am glad to be able to report that I did not find a single tree that had been cut down by the Indians.

On the question of yield, I also cannot state anything definite, as owing to the inclement weather, I could not possibly get any idea as to the yield per tree. I should however, think that 4 lb. per tree per year, could be easily obtained from ten-year-old trees. From the scattered forest giants, I believe a return of some 40 or 50 lb. would be obtained in cases where huge giants, such as the one referred to in an earlier portion of this report are found, and in cases where they have never yet been bled. In planting I think 33 feet distance from each other would be quite safe.

SUMMARY OF RESULTS OF TAPPING RUBBER TREES AT DOMINICA AND ST. LUCIA.

The following brief notes having reference to Castilloa rubber at St. Lucia have been prepared by MR. J. C. MOORE, Agricultural Superintendent:—

There are in St. Lucia no plantations devoted entirely to rubber cultivation, but on several cacao estates *Castilloa elastica* has been planted through cacao fields instead of the usual 'Bois Immortelle' shade tree.

Probably some 300 of these rubber trees range in age from eight to twelve years, and are ready for tapping.

Measurements of a number of trees ranging from five to twelve years old indicate that the average annual rate of growth in height is a little over 5 feet. The average girth of these trees, at 3 feet above the ground, was as follows:-

At five	years of age	—2	feet	4	inches.
„ seven	„ „ „	—2	„	11	„
„ eight	„ „ „	—3	„	0	„
„ twelve	„ „ „	—4	„	0	„

One tree twelve years old was 70 feet high, and 5 ft. 6 in. in girth at 3 ft from the ground.

These trees are thriving in various parts of the more humid districts, on both flat and hillside land, and principally at an altitude of about 700 feet and are planted at distances varying from 40-80 feet apart in cacao fields. There can now be no doubt as to the suitability of the soil and climate in the greater part of St. Lucia for the successful cultivation of this rubber tree.

TAPPING EXPERIMENTS.

In September 1905, our first tapping experiments were commenced on trees in the Botanic Station. The trees tapped were, on the whole, exceedingly poor specimens for their age (fifteen to seventeen years) due to unfavourable soil conditions, and taking this fact into consideration, the results obtained may be regarded as very satisfactory for a beginning.

Details of these tapping experiments have been published in the *West Indian Bulletin*, Vol. VII, pp. 21-9; I will therefore only summarize the points of principal interest.

One tree having a mean girth of 4¾ feet was tapped up to a height of 12 feet by fifty-three V-shaped incisions, and yielded 40 oz. of dried rubber, or an average of ·75 oz. per incision, or ·70 oz. per square foot of tapping area.

The results obtained by tapping nine trees of varying size and age indicate a yield of dried rubber equal to ·50 oz. per square foot of the tapped area, or ·56 oz. per incision. The total number of incisions made were 186 distributed over an aggregate stem area of 208 sq. feet. The average yield of dried

rubber per tree for this tapping works out at about 11½ oz. This quantity of rubber does not appear to be sufficient to compensate the expenditure of labour necessary in working the V-shaped system of tapping.

I have tried the 'herring bone' and 'spiral' methods of tapping, but not sufficiently to warrant a comparison of the relative merits of each; though there is evidence indicating the 'spiral' as likely to be the most expeditious of the three systems.

In connexion with the tapping of *Castilloa elastica*, I mention three questions which might, I think, form the basis of a series of experiments where there is a suitable number of trees available for close observation:—

1. Which system of tapping will give the maximum yield of rubber for the labour expended, and at the same time produce a minimum of injury to the tree?

2. Can Castilloa be repeatedly tapped by successively paring the lower edges of the original incisions as is practised on Hevea in Ceylon?

3. How frequently this, or any other method of tapping may be safely and profitably employed?

Our tapping experiments were carried out in the mornings, this being considered the best part of the day in which to obtain the largest flow of latex.

Extensive experiments in tapping Para rubber trees in the Botanic Gardens at Singapore show that morning and alternate day tapping has a distinct advantage over evening and daily tapping in the yield of rubber per tree. It has been observed in our subsequent experiments, that when a dozen incisions were made in the space of one hour on the same tree, the last made incision gave much less latex than the first. On another but somewhat smaller tree, a total of 53 incisions were made, but with an interval of at least forty-eight hours between each series of five, and it was found that the flow of latex in the later part on the tapping was not noticeably less, but was more liquid and probably contained a lower percentage of rubber.

This decrease in the percentage of rubber in the latex of the later tappings on the alternate system, appears to be counter-balanced by the larger flow. It is well known that on a dry hot day the water contents of a tree may be considerably reduced by transpiration, and sometimes to such an extent as to cause in some plants a visible effect upon the foliage, owing to the rate of transpiration exceeding that of the intake of water at the roots. This probably causes a decreased liquidity and pressure in the fluids of the stem, to which it appears reasonable to attribute the differences in the flow of latex in the morning and evening, or daily and alternate day tappings.

When making a number of incisions on a tree in a comparatively short time, say 12 incisions in an hour, it has been observed that the flow of latex from the last made incision is much less in quantity than that obtained from the first made incision: and it appears reasonable to assume that

this decrease in the flow is due to the pressure of the stem fluids being reduced by the loss of latex from the first made incisions.

In this direction, an experiment was carried out with trees Nos. 8 and 9, which were selected on account of their uniformity in size, shape, vigour, and position, with the object of ascertaining whether a greater yield of rubber could be obtained by tapping a tree at intervals of about 48 hours, than by completing the operations on one occasion.

The results were as expected, the alternate system indicating a gain in dry rubber of 52 per cent.

In preparing rubber from the latex, the later is diluted with three or four volumes of water and then allowed to stand for about four days until the rubber has risen to the surface in a spongy mass, which is then lifted out of the vessel after the coffee-coloured water underneath has been drawn off. The rubber is then worked into the desired shape, well washed in frequent changes of water, and finally pressed to force out any water remaining in the pores of the mass, and dried thoroughly in the shade. Rubber prepared in this way was in January 1906 valued at 5s. per ℔. in London.

DOMINICA.

The following paper on rubber in Dominica has been prepared by Mr. Joseph Jones, Curator, Botanic Station, in which are discussed the suitability of Dominica for the different varieties of rubber-producing trees, and the results of tapping experiments :—

A short note on rubber-yielding plants in Dominica was published in the *West Indian Bulletin* Vol. VII, pp. 16-20 in which the various methods of tapping rubber trees in Dominica were described.

TAPPING EXPERIMENTS.

It was recommended in the case of Castilloa that tapping with a sharp chisel the successive cuts being made to form a 'half spiral of horizontal cuts on half the circumference of the trunk, with a distance of from twelve to fifteen inches between the lines of the spiral,' was a good system, and one that might be followed by planters. An alternate system is to tap the circumference of the trunk leaving a greater distance (horizontally) between the cuts.

It was further recommended for the easy collection of the latex, to form channels round the trunks of the trees with the sheathing bases of the leaf stalks of the cabbage or similar palms. These being hard and dry should be soaked in water a few hours to make them pliable before being tacked on the trees.

Before the tree is tapped it is better to spray the trunk with water. This causes the milk to run down the stem to the channel more rapidly. Castilloa trees yield their latex quickly. The stem can then be washed again ; a very fine nozzle being used. The part of the trunk tapped is thoroughly washed and

all the latex collected in a few moments with a very small quantity of water.

It should be understood that water in any case must be added to Castilloa latex otherwise it hardens and forms scrap rubber.

Sheets of Castilloa rubber of a dark colour, prepared by the creaming method at the Botanic Station, were reported on in London by two firms in 1906 as 'fine thin sheet, well cured,' value at that time 5*s.* 7*d.* to 5*s.* 9*d.* per lb., showing that good rubber can be produced in Dominica.

It would be of great help to growers of Castilloa, especially those who will shortly have trees ready for tapping, if information could be obtained regarding the the form in which it should be shipped, whether in blocks or sheets, and what colour the rubber should be. Castilloa rubber obtained by the creaming method is dark in colour. If the rubber is free from impurities, foreign substances and strong, does the colour affect the price?

Experiments show that amber coloured sheets of Castilloa rubber could be obtained, but only at increased expense on the part of the producer. Would such rubber obtain a higher price than similar rubber in strength and purity, but of dark colour?

The area under Castilloa in Dominica is being gradually extended. A number of plants and a considerable quantity of seeds are distributed annually from the gardens. Planters now know how to deal with the seeds, and very successful nurseries of Castilloa seedlings are to be seen on various estates.

RUBBER-PRODUCING TREES AT DOMINICA.

Castilloa elastica is probably the best rubber tree for cultivation in Dominica. The tree grows well, it can be depended on in eight or ten years to give a good yield of rubber, it is known to withstand fairly satisfactorily the severe gales that sometimes sweep over the island. It can be grown either in plantations by itself, or as a shade tree among cacao where shade is required, or planted round the edges of cacao fields. A good supply of plants and seed can be obtained in the island.

Funtumia elastica, the Lagos silk rubber, which was introduced into Dominica during 1896 has been tried in several parts of the island but it has not proved so satisfactory a plant as Castilloa. It is liable to attacks of scale insects causing black blight, and unless planted in a very sheltered position, the plants are uprooted by strong winds following heavy rains.

Tapping experiments were made in 1906 on a few trees from eight to nine years old. The yield of rubber was small, It was reported on in London as being soft and valued at 2*s.* 6*d.* to 2*s.* 9*d.* per lb. The trees were again tapped a few weeks ago,

but there was no improvement in the yield. Trees tapped on an estate at Windward where there is a rich soil and heavier rainfall than at the Botanic Gardens also gave a poor yield of rubber.

Unless this tree shows considerable improvement of yield when from ten to twelve years old, it will probably fall into the same position as the Ceara rubber tree, *Manihot Glaziovii*, a tree known to give an excellent rubber but the yield per tree is so small that it is not cultivated on a large scale.

Hevea brasiliensis.—Few plants of this species exist in Dominica and little is known of its yield. It grows well when young but is somewhat easily uprooted by the wind. A glance on a map will show that the habitat and the great cultural development of this plant during recent years is confined to equatorial lands, (that is those lying between 10° north and south of the equator) where there are no severe storms. It may grow well in islands like Dominica, 15° north of the equator, but how will it behave when storms sweep over the island? Information on this point would be valuable, if any place similarly situated as Dominica can give it.

Landolphia owariensis.—A wardian case of these climbing plants was received from Kew in 1903. A plot of sixteen plants was started on the hillside, a rather dry situation. The plants have grown well, flowered, and borne seeds. No tapping has yet been done, but the plant is known to yield a good rubber. It may prove a good rubber plant to grow on hillsides in Dominica.

TOBACCO INDUSTRY.

TOBACCO IN JAMAICA.

BY THE HON. W. FAWCETT, B.SC., F.L.S.,

Director of Public Gardens and Plantations, Jamaica.

The history of economic plants in Jamaica is part of the history of the efforts made by the British Government to aid the colonies. The wide knowledge, wise counsels, and great wealth of Sir Joseph Banks were always at the service of the Government for the purpose. In later years, when the Royal Gardens at Kew were presented to the nation, and the establishment there gradually grew in value and influence under the fostering care of the Hookers, father and son, and later still of Thiselton-Dyer, the efforts of the Government became systematic and continuous, and consequently still more valuable to the colonies, especially to such colonies as maintained Botanic Gardens which were in constant communication with Kew.

The history of the tobacco industry in Jamaica is a good illustration.

Sir Joseph D. Hooker has been good enough to state in a letter written in October 1905, what he did to assist it, as follows:–

'When Sir J. P. Grant was appointed Governor,* he, being an Indian friend of mine, asked me what he could do for the introduction into the island of useful vegetable products, and he came and stayed with me for a couple of nights to talk it over. I reminded him that it was a scandal that with the East and West Indies in our possession we had not a good cigar from either, and that in India** nothing but Manila cheroots were smoked by Europeans, and in England Havanas. I suggested my getting seeds, together with histories of their manufactures, of various kinds from Cuba, Manila, etc., through our Consuls, and that he should get some enlightened Jamaica proprietors to commence the cultivation. This we carried out, and in the third year Sir J. P. Grant sent me a sample of tobacco grown in Jamaica from these seeds, which I sent to an expert in London who pronounced it most promising. I also suggested to Sir John offering prizes for the best cigars.

'My old friend Musgrave† sent me several boxes of excellent cigars. Afterwards, the quality of the article went down, some boxes I ordered arrived full of weevils and were carelessly packed, and I gave up smoking the Jamaicas. Quite lately I have had good accounts, and the box you sent bears testimony to them.'

* Sir J. P. Grant, Governor, 1866-74.
** Excellent cigars are now made in India. *J. D. H.*
† Sir A. Musgrave, Governor, 1877-83.

Mr. Robert Thomson, Superintendent of Public Gardens, in his Annual Report for 1868-9, acknowledges the receipt from Kew of packets of tobacco seed of Manila, Havana, and Latakia. A plot was grown at Castleton of Latakia on account of its free-growing and vigorous habit and a sample of it forwarded, through the kindness of Dr. (now Sir) J. D. Hooker, to a London authority on the subject, who reports favourably of it, and says after suggesting some improvements, etc., as to preparing it for market, that 'the general appearance of the leaf is such that its cultivation should be encouraged in Jamaica.'

In the *Jamaica Gazette* for July 8, 1869, appeared a short paper on Tobacco by Dr. Thomas Allen, giving Cuban methods of cultivation and curing.

In the *Gazette* for April 7, 1870, the Governor directed the publication of the terms and conditions under which prizes were offered by the Government of £250 for encouraging the cultivation and curing of tobacco.

In the Report on the Botanical Gardens for 1871-2, Mr. Thomson says:—

'Plots of Manila, Havana, Kentucky, and Latakia tobacco have been grown, and samples of them will be sent to England for valuation. The Latakia, which came from Kew a few years ago, I observe is already very generally cultivated by the peasantry in many parishes, but, like most other cultivated plants in the island, in small patches.

'A great impetus has been given lately throughout the country to the cultivation of tobacco on a much larger scale than formerly. I have, during the last six years, distributed annually at the rate of 200 small packets of five varieties of seeds which were first received from Kew.'

The collector of taxes for Kingston reported on January 2, 1874, that a number of small manufactories of cigars have recently been started in this city, principally by the refugees from Cuba; and although such cigars are very generally made of imported tobacco, yet so much of our own weed is now employed as to affect very considerably the importation of foreign-made cigars.

He further continues as follows:—

'There are also at present in Kingston two large establishments where cigars are manufactured entirely of Jamaica-grown tobacco, and one of these large establishments (Messrs. Soutar's) has succeeded in bringing into notice on the continent, particularly in Austria, Prussia, and Turkey, the superiority of our Jamaica cigars to the ordinary brands of Havana; indeed, so excellent have the cigars exhibited by Messrs. Soutar at the Vienna Exhibition of last year been deemed by the Imperial Commissioners, that a medal has been awarded to them for their exhibit.

'I am also informed that some of our best samples compare favourably with the very best Havanas, and that there is every likelihood of a large export trade being established at no

distant date, and the cultivation of the weed being extended in this country.

'On reference to Customs' statistics, I find that in the year 1871-2, cigars were imported, amounting to 7,202 ℔., whilst in 1872-3, the quantity fell off to 1,963¼ ℔., and that the exportation of our island manufacture has increased from 100 ℔. in 1871-2 to 494 ℔. in the past year.

'It is therefore evident that tobacco will, within a few years, become one of the staples of this island, and will not only displace the imported article, but compete successfully in the markets of the world against all foreign productions of the kind.'

In November 1874, the Governor directed the publication of the following extract concerning tobacco produced in Jamaica, and exhibited at the Vienna Exhibition, 1873, from a Report by Wm. Robinson, Esq., Special Commissioner for the Crown colonies, and Superintendent of the Colonial Section at that Exhibition, upon the British colonies represented there, with particular reference to their produce:—

'The cultivation of tobacco, according to the Cuban system, has made a satisfactory start, and is increasing.

'By the returns of the collectors of taxes, it appears that in August 1871, there were only 91 acres of this cultivation; there are now more than 300 acres. The increase is principally in the parishes of St. Andrew, where the cultivation is carried on by Jamaica owners, and in the parishes of St. Catherine, St. Thomas, Portland, and St. Mary, where it is carried on mostly by Cubans who have settled and become the owners of property. Both Cuban and native labour are employed in the cultivation, but Cuban labour alone is employed in the manufacture. As yet, the tobacco grown in the island is for the most part made up into cigars and snuff for island consumption. But the reports made of cigars sent by way of experiment to the London market are satisfactory. There can be little doubt that tobacco will soon be a great staple of export. The quality is certainly good. There is nothing to prevent Jamaica cigars equalling those exported from Havana.

'In 1870, a prize of £250 was offered for the best tobacco, produced in Jamaica by any cultivator of not less than 8 acres, producing 400 ℔. of cured tobacco from each acre. This prize was equally divided between two competitors in 1872. These were the first producers in Jamaica of tobacco as an exportable article.

'Cigars were the only produce of Jamaica exhibited at Vienna, and they received the Medal of merit. Messrs. Soutar & Co., of Kingston, sent 2,000 of different sorts, which were excellent both in quality and in make. They formed quite a feature in the colonial annexe, and five times that number could have been sold as samples had they been placed at my disposal.

'The plantations of Messrs. Soutar are 15 miles from Kingston, and were established four years ago upon a soil similar by analysis and in a climate corresponding with, that of the

famed Vuelta Abajo District in Havana. Their seed was also received from, and is of the description grown in, Vuelta Abajo. Their manufactory is in Kingston, where they constantly employ 100 hands in the preparation of the tobacco, and manufacture of cigars and cigarettes. The cost of freight from Jamaica to Great Britain is about 3s. per 1000 cigars, and to the Continent from 3s. to 3s. 6d. Persons disposed to question the value of Jamaica tobacco frequently stated to me that transplanted tobacco changes its character, and that therefore the cigars could not be as good as Havanas. The impression that it changes in character is correct. That delicate aroma found in the Vuelta Abajo tobacco is not derived from the seed but from the nature of the soil, the climate, and the temperature.

'When first establishing plantations in Jamaica some five years ago, Messrs. Soutar were of course aware of this fact, and tried the growth in three different localities, all sown with the same seed, which was obtained from one of Partaja's plantations in the district of Pilotes in the Vuelta Abajo.

'One plantation gave a very good quality, another a tobacco similar to that grown about Santiago de Cuba, and the other a strong but flavourless leaf, each differing according to the soil and climate, although all were cured in the same way. It was not until they had obtained a correct analysis of the soil of the Vuelta Abajo, together with a record of the temperature and other meteorological phenomena, that they met with any degree of success, and indeed it is only now that they have been able to secure a property having all these conditions.

'This year's crop appears better than last, and Messrs. Soutar are confident that next will be equal to the finest Vuelta Abajo.

'I have had much pleasure in forwarding several large orders to Messrs. Soutar from Vienna, and I am convinced that if, through these orders, they obtain a footing in Germany, a prosperous future will be in store for them.'

Sir John Peter Grant, thé Governor of Jamaica, with whose name the increasing prosperity of Jamaica will ever be associated, reports that 'in the Castleton Gardens, plots of Manila, Havana, Kentucky, and Latakia tobacco have been grown. The first and last of these tobacco plants seem to thrive peculiarly well. The sudden spring that the cultivation of tobacco has just taken in this colony, renders the question of tobacco seed one of great interest and importance. Our garden must possess all the most highly prized varieties of this plant. But from all I can learn, Jamaica has as good a right to send tobacco seed abroad as any other place has. I have heard of a preference being given to the seed of Jamaica plants to seed imported from Havana of the same variety, and I have heard of Cuban settlers here who have pronounced the quality of some leaf now growing here, upon plants whereof the cultivation happened to have been attended to with the needful care and skill, to be already equal in size and quality to that of the best Cuban leaf.

'For a few years past the Superintendent of our Botanic Garden has been distributing here small packets of tobacco seeds, at the rate of 200 packets a year. These packets contain five varieties of seed, originally procured from Kew.

'I cannot mention Kew without observing that infinite as have been the services of Dr. (now Sir) J. D. Hooker to every part of the British Empire, there is no spot in that Empire which has greater reason for gratitude to that eminent man than this island of Jamaica.'

In his Report on the Botanic Gardens for 1873-4, Mr. R. Thompson writes as follows :—

'At the request of the Government, Her Britannic Majesty's Consul-General at Havana forwarded in September a bag of the famous, and scarcely to be obtained, Vuelta Abajo tobacco seed, weighing upwards of 20 lb. This made up the quantity I possessed to 30 lb., which was advertised for public distribution gratis. Upwards of 100 applications were made for it, and fifty-four of the earliest applicants received each a packet of about ½ lb., the others receiving smaller ones. Many of the applicants stated that they contemplated the cultivation of this product on a large scale, and it is thus to be hoped that millions of plants will be produced from these seeds.

'The successful cultivation of tobacco in Jamaica is now an accomplished fact, and it may be considered one of our staple products. Considering the paucity of the staple products of Jamaica, the desirability of introducing new objects of cultivation, and the reluctance exhibited on the part of private enterprise to embark in new undertakings, the position that tobacco has taken is highly gratifying, and augurs well for the future of the island.

'Considerable difficulties have to be encountered in the introduction of a new cultivation: amongst others are a proper selection of soil and climatic conditions, and the ignorance of the peasantry both with regard to cultivation and manufacture, and it is to be hoped that persons entering upon this cultivation will duly consider such difficulties, as there can be no doubt that success will, in a great measure, depend upon their doing so.

'It should be remembered that it is to the Cuban refugees that we are mainly indebted for the introduction of the tobacco cultivation, for it is to their enterprise, and to the advantage that has been taken of their skill, that we must attribute whatever has been done in regard to this. Amongst those gentlemen who deserve the best thanks of the country for their determined and persevering efforts to establish this important industry, I would mention the name of Simon Soutar, Esq., whose beautiful cultivation of 100 acres of tobacco does him great credit. With regard to another gentleman who has also taken a leading part in the establishment of this plant, I have great pleasure in extracting the following valuable notice from the *Journal of Applied Science*, the editor of which is a high authority on colonial vegetable products. A writer in that journal, treating of the importance of colonists, in view of the increasing competition in the

production and manufacture of the great staples, turning their attention to minor products, makes the following remarks with regard to tobacco:—" The Spaniards have hitherto monopolized this trade alleging that parts of the soil of Cuba were alone suited to the production of the Havana tobacco. This assertion is now disproved, for with good choice of seed, soil, curing of the leaf, and skilled manufacture of the cigars, Jamaica now sends into the market as excellent a cigar as was ever shipped from Cuba, and at a far cheaper rate. We have lately been favoured with samples of excellent cigars from the estate of Count José Duaney, Jamaica. He was among the first to introduce the planting of the real Cuban seed there, and his estate, Hall Head, which is in a district in the east of the island, has produced the best cigars up to the present time, although many other estates have gone into tobacco culture. If the quality of this brand be maintained, and the remarkably low price at which they can be sold wholesale continued, it will be a real boon to smokers, and lead to extensive orders."

Mr. Simon Soutar has favoured me with the following excellent account of his connexion with the rise of the industry. The knowledge of the capabilities of Jamaica as a competitor of the Vuelta Abajo district in Cuba, is doubtless in great measure due to Mr. Soutar's energy and perseverance :—

'In 1863, I was in Havana and was struck with the great prosperity of the tobacco industry and the great influence it had on the commerce and prosperity of that port. In those days, Peru with its guano deposits, and Chili with its silver mines were very prosperous, and along with London took the entire crop of the finest cigars made, regardless of price; and while I was there the wharves were lined with cases of the finest cigars being shipped to those markets. On every hand I saw at least one-half the prosperity of Havana assured from its proximity to the great tobacco district, the Vuelta Abajo. 'I tried to get some seed then but failed, and what I got a year or two afterwards appeared to have been fried, as it failed to germinate.

'At the close of the American war, a Kentuckian, Capt. Field, who had served with the Confederate Army, came to Jamaica and posed as a Kentucky tobacco planter. I started him on "Bellevue," owned by the late O. M. Feurtado, but then the property of Mr. Derbyshire.

'Capt. Field got seed from Kentucky and grew tobacco, but it was a long leaf and suitable only for smoking purposes. About 1868 or 1869, we got some Havana seed, through Sir J. D. Hooker and the Superintendent of Public Gardens, with which I started cultivation with Capt. Field at Bellevue, and with Pedro Cisreros, a Cuban from Manzanilla at Cherry Garden, now the residence of Major Marescaux. The tobacco grew very well but had no Vuelta Abajo flavour. I next tried the banks of the Rio Cobre at Cross Pen and several other places but without satisfactory results. Meantime I thought the Wag Water Valley both in soil and meteorological conditions similar to the Vuelta Abajo, and procured a sample of soil which was sent to Pelletier, the celebrated French Chemist, for analysis.

It was found to be very much like a similar sample already analyzed by the same Chemist from the Vega Pilotos, a rather celebrated vega belonging to Partagas & Co. I secured some land at Temple Hall in 1870, but being late, very little was done that year, and it was not until 1872, when I got José Pita, a planter from the Vuelta Abajo, that I was able to produce a tobacco equal to Havana. In that year I got about twenty of the best Havana cigar makers, revolutionists who came to Jamaica as refugees—Sestero, Badell, Pino, and others, all celebrated workers from the factories of Partagas, Cabanas, and "La Honradez." They made the cigars I exhibited at the Vienna Exhibition in 1873, and which gained the highest Medal and Diploma, and secured orders from Prince Milan (afterwards King of Servia), the Sultan of Turkey, and a number of other notables who considered them better than the usual run of the Havana cigars of that day. The Commissioner in charge of the Colonial Section at the Vienna exhibition was Mr. William Robinson (afterwards Sir W. Robinson, Governor of Trinidad) from the Colonial Office, Downing Street, who took a very great interest in the exhibit, and my success was no doubt greatly due to his good and judicious management. I exhibited again in 1876 at the Centennial Exhibition, Philadelphia, taking the highest honours and medal, in many instances higher than my Havana competitors.

'The Government prize of £250 given for the encouragement of the tobacco industry was equally divided between Mr. Derbyshire and myself, that being in the opinion of Messrs. Kemble and Trench, the best way of encouraging the industry. A subsequent prize of £50 given by the London Chamber of Commerce was awarded to B. & J. Machado for a sample of Temple Hall tobacco. I have sold Temple Hall tobacco in Jamaica for £25 a quintal and in Bremen, then the greatest tobacco market in the world, at 5*s.* a pound. Some Cherry Garden tobacco was sold in London by Grant Chalmers & Co. at 3*s.* 6*d.* a pound.

'Tobacco being a garden cultivation requires constant attention and supervision. It necessitated my living at Temple Hall and spending three days a week there, coming into town on Tuesdays, Thursdays, and Saturdays, and also neglecting my town business to a great extent. Then a number of people had by this time gone in for the cultivation of tobacco and manufacture of cigars and were flooding the foreign markets with questionable Jamaica cigars to my prejudice, so I gave up the factory in favour of the Machados, renting the lands to Cubans.

'The system of cultivation pursued now, is that of the Vuelta Arriba, and can never produce a high-class tobacco. It shows that our tobacco is good when with such treatment we are able to produce a smokable cigar, but if they would only get some good Vuelta Abajo planters, and grow the tobacco in the proper localities with the same careful cultivation and selection that obtains in the Vuelta Abajo, our cigars would compete with, if they did not excel Havanas. The Vuelta Abajo lands were supposed to have deteriorated very much. During the time they were using large quantities of Peruvian guano,

their tobaccos lost that dry nutty flavour they had in the sixties. Then, as the demand increased and the manufacturers were unable to fill all orders, they resorted to Porto Rico and Sumatra tobacco, which have no Havana flavour.

'I always found the Department of Public Gardens and and Plantations very ready and anxious to help the tobacco industry, but it must be grown much as the cotton is grown in the Southern States, by families dependent upon results, who cultivate small holdings, giving them constant care and attention.'

In the Report on Public Gardens for 1876-7, it is stated:— A small packet of Bhilsa tobacco seed was received last year from the Royal Gardens, Kew. This is the most highly reputed of all the Indian kinds: only a few plants were raised, these it was necessary to reserve for seed-bearing. They made an extraordinary robust growth, and otherwise presented many of the characters which give value to the best varieties of tobacco. About 2 lb. of seed was saved, which I distributed among the principal growers on the island for their trial and report.

Messrs. Charlton Thompson and G. A. Weitzman cultivated tobacco from 1875 to 1884 in Jamaica; they had 150 acres at Potosi and 50 acres at Morant in the Blue Mountain Valley in the parish of St. Thomas, and 50 acres at Collbecks near Old Harbour in St. Catherine. They used Sumatra, Java, and Havana seed, but the best results were from Havana.

The following memorandum, furnished to the Governor, (Sir A. Musgrave,) by Mr. Weitzman, was published in the Report on the Botanic Gardens for 1878: 'The results obtained by different planters are, as is well known and admitted, even by Cubans not interested in this undertaking of the greatest importance, and have proved beyond a doubt that our produce is one worthy of attention, and one which will stand competition with that of other countries, the reputation of which has been established long before. As the result of my journey to England and Germany last year, I may mention that in the Hamburg market, the most considerable in the world for tobacco, I found that our produce stood next in rank to the Havana tobacco, to which it was pronounced inferior, but superior to all other kinds, even not excepted those other parts of Cuba, such as St. Jago, Manzanillo, Yara, etc., which furnish such a very considerable quantity to the consumption at home. . . . .

'As for the outlet and sale of our produce, every one interested has found that the German markets, especially that of Hamburg, has given it the best reception and greatest encouragement. Our tobacco is readily sold there, and, though the first hands may buy it as Jamaica, the consumer in most cases will not know better than that it is Cuban or even Havana. . . . .

'Jamaica has shown that it can produce a tobacco which has proved itself worthy of being introduced as a new article of industry, and, considering the short time that has elapsed since it was first established as such, we have gained a by no

means small success. Whatever faults there may exist about the different branches, there are none which time cannot overcome.'

In his first Report (1879-80) as Director of Public Gardens and Plantations, Mr. (now Sir) D. Morris quotes from Mr. Weitzman as follows:—

'There are very encouraging signs of a steady demand for our cigars in England, as well as on the Continent of Europe. In the German markets, which are considered the most important for leaf tobaccos from all parts of the world, Jamaica tobacco sent there for sale was well thought of and ranked in price next to the celebrated Havana leaf, as it distinguished itself from most of the other Cuban varieties, by its fineness of texture and mild agreeable flavour, and an absence of all rankness so often met with in the latter.

'Since last year, the consumption of Jamaica cigars in England has spread in an extensive manner, and the demand for our production now gives employment to a great number of hands. Of the workmen that are employed, by far the larger number still are Cubans, but we are glad to see the natives gradually adopting the profession and taking part in the general competition.'

In the Report for 1883-4, the Director says: 'The cultivation of this once promising industry on a large area would appear to be decreasing, chiefly owing, I believe, to want of success in properly curing and preparing the crop for the market.

'In many parts of the island, however, tobacco growing in small patches is being extended gradually, and numerous applications are made for the best qualities of Havana tobacco seed.

'As is usual, not only in Jamaica but in most of the West India Islands, there is a great want felt for plain practical hints as to the cultivation of new economic plants, and the preparation of the produce so as to gain good and remunerative prices.

'On the subject of properly curing tobacco, which is one of the most important points connected with this industry, and one, moreover, in which most Europeans who have attempted it in Jamaica have failed, there is a great demand for reliable information. The Cubans settled in the island are apparently the only persons who can cure tobacco properly, but unfortunately, their numbers are decreasing, and in many cases they take up other industries which appear to them to offer better returns for their labours.'

He also quotes from a communication to him from Dr. Neish as follows: 'General Vijegas, formerly of Cuba, but now an extensive cultivator of Havana tobacco at Colbeck's Plantation,* informs me that sowings of tobacco seed are usually begun in August with successive sowings throughout the following

* Near Old Harbour, St. Catherine, Jamaica.

months, namely, September, October, November, and December, and mentions that the earlier sowings give leaf of very mild quality, with fine flavour, and that the later sowings furnish stronger tobacco, the leaves gaining in strength with the advancing season. The very strongest kinds are furnished by plants sown in November and December. His opinion is that there are in Jamaica many thousands of acres well adapted for the cultivation of Havana tobacco, and that, contrary to a common opinion, the drier parts of the island, provided suitable soil be selected, are quite well adapted to tobacco. He maintains that it is only in the season of planting out that much moisture in the soil is essential; that tobacco grown in a comparatively dry district will have a fine and distinct flavour, different in aroma to that grown in a wet locality. Further, I have his authority for the observation that tobacco grown in wet districts, such as parts of the eastern end of the island, and in some northside parishes, will not keep long, but must be sent to the European markets as soon as it can be cured, and that cigars made of such tobacco will not keep for more than a year without deteriorating, both in appearance and quality, whereas tobacco grown in a drier climate will keep longer, and cigars made from the latter kind will keep for fully three years. His opinion is that there is a very general liking amongst English smokers for cigars mild as to strength, but delicate in aroma - a taste which is met by well-known and well-cured Havana tobacco grown in a rather dry but not arid climate. He says there is plenty of good soil in Jamaica, at present in ruinate, perfectly adapted to grow this quality of tobacco, ranging over an extensive tract of country comprised principally in the parishes of St. Catherine and Clarendon.'

In 1884, Messrs. Thompson & Weitzman failed, their Agents in England having overtraded and their capital having become exhausted.

In the year 1888, the London Chamber of Commerce offered a prize of fifty guineas for the best specimen of tobacco grown in India or in any of the British colonies and possessions. Each specimen submitted was to consist of a minimum quantity of 400 ℔. in weight. The prize awarded in the following year was divided between samples from Jamaica and British North Borneo. The Jamaica winner was the firm of Messrs. B. & J. B. Machado, whom I persuaded to enter for the competition.

As the Cubans alone, speaking generally, understood the art of cultivating and curing tobacco, any increase of the industry among the native small settlers could only be successful and permanent if reliable and practical information could be given in a form that could be assimilated by them. An attempt in this direction was made in 1889 by the publication of a short treatise on tobacco in the Jamaica *Bulletin* by Mr. J. C. Espin, a Cuban.

In 1893, 25 ℔. of the best Vuelta Abajo seed was obtained from the British Consul-General in Havana and distributed to growers, and other consignments were received from time to time in subsequent years.

In 1897-8 and in the following year tobacco was grown at Hope Gardens for the express purpose of obtaining a large stock of seed from carefully cultivated and well grown plants both of Havana and Sumatra varieties.

During the years 1898-1901, a very important experiment in cultivation on a large scale was undertaken by the Hon. Evelyn Ellis at Montpelier in St. James. No less than 150 acres were cultivated in tobacco, and no expense was spared to make the experiment a success. A short account of this undertaking was published in the Jamaica *Bulletin* for January 1899. Other industries were under experiment at the same time, such as dried bananas, and cattle food, under the management of Mr. Zurcher. But none of the experiments appeared likely to yield a profit, and they came to an end in the year 1901. Some excellent tobacco and cigars were produced, but the soil is not of the proper physical texture to give really good results.

Mr. J. C. Espin's treatise on 'Tobacco Cultivation and Curing' was published in the Jamaica *Bulletin* for October 1899.

In the Annual Report for 1898-9, I wrote as follows: 'The engagement of an expert in curing tobacco at Montpelier at a high salary is justified as a mere matter of business. It would be a great boon to the whole island, if an expert of like character would be attached to the Hope Gardens to demonstrate in his work there to all comers the manifold minutiae of the process of curing. When there was no work that required his presence at Hope, he could travel through the island, giving public demonstrations, examining tobacco, undergoing curing at different estates, and affording advice and assistance in every way to any who should seek it.'

'At present our means of instruction are very limited, but every one who receives seeds may also have the Jamaica *Bulletin* (May 1889, No. 13), written by a Cuban expert, dealing with the cultivation and curing of tobacco.

Obtaining an expert knowledge of the curing of tobacco was rendered possible when Mr. T. J. Harris was appointed Assistant Superintendent of Hope Gardens with the special care of the economic section. In 1900-1, about 4 acres of tobacco were grown at Hope Gardens for the purpose of investigating the proper methods of cultivating and curing A curing house was built and an attempt made by Mr. T. J. Harris to cure the leaf from the study of Espin's treatise and from information received from Cubans. The first cutting failed, and an arrangement was then made with a Cuban tobacco planter, Mr. Antonio Leon, to come to Hope Gardens from time to time and advise on the cutting and curing of the crop. Four acres were again planted in the following season (1901-2), and from the experience gained during the two seasons, Mr. T. J. Harris was enabled to prepare articles on the cultivation and curing of tobacco for publication in the Jamaica *Bulletin*. These articles appeared in the *Bulletin* for April, May, and October, 1902, and were also issued as leaflets for general distribution. The different value to be placed on the two treatises—the one by Mr. Espin and the other by

Mr. T. J. Harris—may be expressed by saying that Mr. Espin wrote as one familar with the subject from boyhood, and so unconscious of the difficulties of the inexperienced ; Mr. Harris wrote as one who had failed over and over again, and who had only gained his knowledge by careful study of the information received from Mr. Leon and other Cubans in correction of details of practice which had caused previous failures.

I attach great importance to having been enabled by the Government to secure that one of the staff should have had the opportunity to qualify himself as an expert in tobacco. His experience was put in writing for the benefit of others ; men were trained by him in the Department who have carried on the work since he left, and a practical school' for teaching the apprentices and others was started at Hope Gardens which ought to exercise a very great influence on the extension and improvement of the tobacco industry in the island.

As stated in the Report for 1898-9, I consider that besides the practical training which is now going on at Hope Gardens, it would be well to have trained men travelling through the country during the tobacco season offering advice to growers in cultivation and curing. Large growers can always secure the services of a Cuban, but small settlers require demonstrations in their tobacco fields and in their curing houses to supplement and to illustrate the teaching imparted in the leaflets on tobacco.

In 1902-3, only 2 acres were planted for the purpose of giving the apprentices an opportunity of gaining practical experience; and in the following year 1903-4, besides 2 acres in Havana tobacco, ¼ acre was grown in Sumatra tobacco under a cheese-cloth tent to test whether the very expensive Sumatra wrapper imported from America could not be grown in Jamaica. The result of the experiment was to show that under cheese-cloth a very fine grade of wrapper can be grown, quite equal if not superior to that imported from America. Owing to the dryness of the climate at Hope, difficulty was experienced in curing, but this was overcome on further trial during the following season (1904-5). During the next year (1905-6) the Sumatra tobacco was grown in the open as well as under cheese-cloth, and the opinion of an expert, Mr. F. V. Chalmers, was that the sun-grown Sumatra was superior to that grown under cloth, and that the flavour of both kinds and of the Havana is 'unsurpassable when fully fermented.'

A small sample of the Sumatra tobacco grown under shade cloth was sent for report as to quality and value in the English market to the Imperial Institute in the year 1905. The Director, Prof. W. R. Dunstan, reported as follows :—

'The sample consisted of six leaves of the *wrapper* type of cigar tobacco showing a dull, olive-brown tint. The leaves were of fair length, uniform in colour, thin and free from stains and burns. They were somewhat brittle when handled, but this was probably due to their having been packed between sheets of cardboard which had absorbed the moisture, rendering the leaves abnormally dry. When ignited, the tobacco

burned evenly and steadily, evolving a fairly fragrant aroma and leaving a greyish white ash.

'As the sample was very small, it was impossible to submit it to chemical examination. It was therefore sent to a firm of tobacco experts to be tried for *wrapping* cigars and for the determination of its commercial value. The experts' report on the tobacco was as follows:—

"The tobacco is of a very handsome appearance, thin in texture and therefore highly productive as a *wrapper* for tobacco; in use it is somewhat *tender* and does not appear to have quite as much elasticity as Sumatra tobacco of similar texture; the burning is very fair and the flavour not unsatisfactory. Similar tobacco, well put up, would fetch on the English market up to about 3*s*. per lb., for first lengths, say 2*s*. 3*d*. per lb. for the second lengths, and from 1*s*. 3*d*. to 1*s*. 6*d*. per lb. for the third lengths.

"We feel sure that the soil and climate which have produced this tobacco, are suitable for growing *wrapper* tobacco, equal to most in the world, and if labour is plentiful and cheap, and the area of suitable ground large enough, there is a chance, in time, of this district of Jamaica becoming a serious competitor of Borneo, Sumatra, and Java.

"It will, however, be advantageous to prepare tobacco of this class in a similar manner to that in which East Indian tobaccos are got up for the European markets. If it were put on the market in the same form as the Mexican, Havana, and other West Indian tobaccos, this would probably detract considerably from its value."

'The experts go on to suggest that it might be worth while to carry out a similar cultivation experiment in Jamaica with Java tobacco as this would probably yield a *wrapper* leaf, which would be stronger in texture and of even better flavour than the present sample.

'The results of the experts' trial of this tobacco show that it is of good quality and that if a similar quality can be placed on the English market in quantity it will probably realize remunerative prices.'

As Mr. T. J. Harris was able by his experience to prepare notes for the use of others in cultivation and curing Havana tobacco, so his successor, Mr. W. M. Cunningham, with experience of two crops of Sumatra tobacco, prepared notes for the use of those who are about to grow Sumatra seed for wrappers. These notes were published in the Jamaica *Bulletin* for July 1905.*

The following tables showing the quantities of cigars, tobacco, etc., imported into, and exported from, Jamaica during the years 1871-1906, together with their estimated values, are of considerable interest:–

* The notes prepared by Messrs. T. J. Harris & W. M. Cunningham were reprinted as *Pamphlet No. 38* of the Imperial Department of Agriculture.

TABLE I.

Imports of Cigars, Tobacco, etc., into Jamaica during 1871-1906.

Year.	Cigars.		Leaf.		Manufactured.	
	Quantities.	Values.	Quantities.	Values.	Quantities.	Values.
	lb.	£	lb.	£	lb.	£
1871-2	7,202	2,880	137,759	5,165	133,805	14,271
1872-3	4,111	1,644	173,820	6,518	97,547	9,754
1873-4	2,253	901	128,006	4,800	95,795	9,579
1874-5	1,512	604	168,163	6,306	154,523	15,452
1875-6	1,536	774	171,120	6,417	73,249	7,325
1876-7	1,043	483	125,807	4,718	102,114	10,211
1877-8	1,485	607	139,950	5,506	143,771	12,821
1878-9	902	496	113,471	4,728	80,570	6,043
1879-0	531	318	111,757	4,191	112,992	7,533
1880-1	990	519	139,574	5,234	94,918	7,119
1881-2	392	267	89,080	3,526	76,473	5,736
1882-3	566	346	129,028	5,376	97,182	7,346
1883-4	496	334	127,537	4,778	83,736	6,367
1884-5	1,016	647	123,679	4,638	87,848	5,490
1885-6	657	730	99,934	3,748	88,131	6,786
1886-7	507	428	103,921	4,330	119,187	9,927
1887-8	189	163	124,556	5,190	93,477	9,138
1888-9	432	319	119,875	4,496	114,322	11,237
1889-0	98	106	56,511	2,119	73,107	6,619
1890-1	586	360	152,911	5,734	135,411	12,711
1891-2	229	518	115,845	4,344	125,727	12,059
1892-3	224	139	132,505	5,521	149,833	14,547
1893-4	302	218	141,943	5,914	154,111	16,256
1894-5	152	87	116,496	4,854	122,578	12,729
1895-6	69	65	136,038	5,668	158,193	11,865
1896-7	41	31	116,114	2,903	135,536	12,965
1897-8	58	29	110,157	1,836	136,886	10,153
1898-9	170	60	85,062	1,418	128,429	11,289
1899-1900	22	13	81,264	1,354	43,609	2,180
1900-1	36	30	49,898	832	93,974	9,705
1901-2	69	51	64,722	1,078	106,748	10,933
1902-3	28	17	45,880	765	98,403	10,281
1903-4	37	26	50,121	835	96,158	9,975
1904-5	88	106	40,443	674	82,449	8,640
1905-6	153	154	59,614	994	117,075	12,668

TABLE II.

EXPORTS OF CIGARS, TOBACCO, ETC., FROM JAMAICA FOR 1871-1906.

Year.	Cigars.		Leaf.		Manufactured.	
	Quantities.	Values	Quantities.	Values.	Quantities	Values.
	lb.	£	lb.	£	lb.	£
1871-2	100	25				
1872-3	317	55	896	48		
1873-4	2,733	537	5,600	455		
1874-5	367	162	26,723	1,810		
1875-6	2,633	283	81,510	1,054		
1876-7	2,082	671	68,239	1,030		
1877-8	3,171	757	54,311	5,585		
1878-9	3,796	1,423	135,051	8,441		
1879-0	9,826	4,913	35,271	1,323		
1880-1	25,928	13,612	77,007	2,569		
1881-2	19,216	10,088	85,365	1,268		
1882-3	4,711	2,398	22,990	1,029		
1883-4	4,993	2,122	6,662	333		
1884-5	4,690	1,993	2,019	156		
1885-6	4,509	2,029	520	25		
1886-7	4,252	2,126	350	17		
1887-8	7,008	3,504				
1888-9	4,179	2,800	1,593	79		
1889-0	4,193	2,096				
1890-1	10,892	5,446				
1891-2	18,858	9,429	990	34		
1892-3	10,235	5,117				
1893-4	13,747	6,873				
1894-5	17,469	8,821				
1895-6	15,297	7,648				
1896-7	19,960	9,980				
1897-8	27,966	13,983	38,613	2,648	9,729	1.459
1898-9	30,592	13,120	24,525	1,214	31,520	2,889
1899-1900	30,009	11,530	85,932	4,387	12 735	1,502
1900-1	44,726	15,654	101,350	5,067	17,404	1,958
1901-2	39,122	11,904	47,889	2.394	13,759	1,548
1902-3	41,888	17,590	4,824	157	19,462	2,614
1903-4	34,428	16,752	12.109	582	17,035	2,233
1904-5	35,438	18,372	15,775	613	23,791	3,289
1905-6	40,325	20,312	6,554	246	11,261	1,251

In the year 1897, the Government imposed an excise duty on cigars and cigarettes manufactured in the island, and charged also a duty for licences for manufacturing and retailing.

The Cigars and Cigarettes Law of 1897 enacted—that manufacturers of cigars and cigarettes should be licensed, and pay a duty of 20*s*. on every 100,000 cigars made, and 5*s*. on any number of cigarettes; that every retailer shall take out a licence, paying a duty of 5*s*., for every place of business, and shall enter into a bond; that manufacturers shall pack cigars and cigarettes in such receptacles as are approved by the Governor-in-Privy-Council, to which a stamp shall be affixed; that importers of cigars and cigarettes shall affix a stamp to each package; and that an excise duty be imposed and payable by means of stamps at a rate for cigars of 6*d*. per 100 retailed at a price not exceeding 8*s*. 4*d*. per 100, of 2*s*. per 100 when retailed at a higher price, at a rate for cigarettes of 1*d*. per 100; and provisions for bonding and for keeping books.

This law came into operation on June 20, 1898. The provisions of the new law were felt to be onerous by those engaged in the industry, and the results were disappointing to the Government. The Collector General in his Annual Report for 1898-9 states:—'The newly levied duty on cigars and cigarettes between June 20, 1898 (the date of the coming into operation of the law) and March 31, 1899, yielded £2,543 or at a rate of about £3,400 a year. I am free to confess that I am disappointed at the return from this source of revenue, and at the reception the law met with on its being put into operation. Everyone admits that cigars form a legitimate object of taxation and that the duty imposed is a light one, and well within the ability of consumers to pay, and the methods of enforcement were practically those in force elsewhere, where excise restrictions exist; yet as soon as it was sought to put the law into operation, it met with most strenuous opposition. By relaxing many of the provisions of the Statute, the Department has striven to collect the duty without friction, but it is manifest that without a modicum of co-operation on the part of those concerned, the law must either be a practical dead letter; or the alternative is for the Department to enforce it rigidly; and this would create friction and possible hardship. If a method can be found whereby the restrictions on the trade are removed while the duty, which is admitted to be a proper impost, can be brought into the exchequer, there will be no longer any appearance of excuse for opposition to the law.'

The area of cultivation in 1898-9 in St. Andrew and St. Catherine fell off considerably—a large number of Cubans having left the island. This exodous was no doubt partly due to the close of the Spanish American War, but probably it was largely increased by inability or lack of desire to conform with the restrictions on the trade imposed by the new law. The Government decided to alter the law in certain particulars, and the Tobacco Duty Law of 1900 was passed, which repealed the law of 1887, and placed the duty on getting a licence at 5*s*.

per 10,000 cigars; at 5*s*. for any number of cigarettes: added a duty of 5*s*. for the preparation of any amount of pipe tobacco; changed the excise duty for cigars to 1*s*. per 100 for all kinds, for cigarettes to 1*d*. per 100, and added 6*d*. per lb. for pipe tobacco; made provisions for keeping a stock book and a record of tobacco used, for making monthly returns and checking same by the collector; removed duty on exports of tobacco, cigars, and cigarettes.

The Tobacco Duty Law of 1902, while still providing for licences for manufacture and sale, abolished the duty on licences; placed the excise duty for cigars at 3*d*. per 100 when retailed at a price not exceeding 5*s*. per 100, at 1*s*. per 100 for cigars selling at more than 5*s*. per 100, for cigarettes at 1*d*. per 100, for pipe tobacco at 6*d*. per lb.

COST OF CULTIVATION FOR LARGE GROWERS.

A planter in Upper Clarendon who has cultivated 6 acres in the season 1905-6, states that the actual money spent on cultivation, curing, and erecting a tobacco curing house was £238 2*s*. 0*d*. He estimates that £40 should be added to this for fencing, use of stock and implements, the timber for the house, and cases for shipping the crop, not charged in above, making the total expenditure for the first crop of £278 2*s*. 0*d*.

But part of this expenditure should be spread over, say, six years—clearing the land, preparing and fencing the field, felling timbers, erecting and roofing tobacco house, etc.,—say, £90.

For this reason, deduct £75 from £278, making the cost of cultivation and curing of 6 acres £203, or nearly £34 per acre.

It is admitted that in keeping the field in first rate garden cultivation all the time, more money was spent than was necessary. On the other hand, no charge is entered for supervision; and the wages of a man sufficiently qualified to grow, cut, and cure tobacco would amount to 30*s*. a week at least, while the work lasted from November to June

At Hope Gardens insect pests are not troublesome, but in the cultivation under discussion a constant gang of labour had to be employed—picking worms and caterpillars from planting to cutting. This expense would probably not be so heavy in succeeding years, as the ground would be free from weeds, decaying roots, etc. No rent or taxes are included in the above statement.

The same planter writes: 'In my previous experience, taking good average years, and with all the economy that can be practised, cigar tobacco -carpa and tripa unclassified—cannot be *grown* under 6*d*. per lb., and I am under-, rather than over-, stating the cost. In unfavourable circumstances, and a light crop, it will cost double that.'

Another planter with considerable experience of tobacco grown at Colbecks in St. Catherine and elsewhere, says: 'It is impossible to grow and cure tobacco of the Cuban variety in Jamaica and to put it f.o.b. at less than 9*d*. per lb.'

YIELD.

The yield in a good season, according to the testimony of Cuban planters in Jamaica, is from 600 to 700 lb. per acre, including all qualities of leaf, and of this it is expected that not more than 50 lb. would be of the third quality (fonque). If the crop does not amount to more than 500 lb. on account of bad seasons, the Cubans consider that the crop has not paid. With good soil, and good seasons, and where cultivation is carefully looked after, as much as 800 lb. is obtained, of which perhaps 60 lb. will be of third quality.

In Upper Clarendon, the crop from 6 acres weighed 5,000 lb., five months after the curing was complete. This was a high yield, due to the soil being very fertile, and not yet adapted to producing the best leaf for thin and light wrappers.

Of these 5,000 lb., only 300 lb. were of third quality—evidence of care and attention during cultivation and harvesting.

One acre of Sumatra seed at Temple Hall was very unfortunate in meeting very heavy wet weather, and only yielded 200 lb., one-third of which was wrapper.

PROFIT.

(*a.*) *Large growers.*

The crop of 6 acres in Upper Clarendon was sold in Kingston in the November following, when it had lost one-sixth of its original weight:—

4,700 lb. (wrapper & filler) at 75*s.* per 100 lb. .	£176	5	0
300 „ (third quality) at 3*d.* to 6*d.* per lb., say	5	15	0
Total	£182	0	0

Considering good quality of leaf (wrapper and filler) only, (4,700 lb.) the cost was £4 6*s.* 4*d.* per 100 lb. or 10½*d.* per lb., and the price realized was only £3 15*s.* per 100 lb., or 9*d.* per lb.

My friend writes: 'Taking one year with another, it certainly cannot pay the growers at 9*d.* per lb. When I grew it before the business was killed by the cigars and cigarettes law, I sold the entire crop readily—unclassified—at 100*s.* and 110*s.* per 100 lb.'

Another planter in Upper Clarendon who experimented with nearly 40 acres of tobacco, of which half was of Sumatra seed, says: 'At present prices, there is little or no profit in growing the ordinary article for the local market where the grower has to employ a practical and reliable man to supervize the cultivation, as compared with the case of the grower being qualified to manage and work his own crop.

'I am continuing my experiment with wrapper of both kinds as I believe the native wrapper, if properly cultivated, cured, and allowed to mature, will in time supplant the imported Sumatra.'

(*b*.) *By Cuban Small growers.* The cultivation by Cubans is carried on by themselves and families and hired Cuban labour.

The cost is calculated at £12 per acre for land previously worked, and at £15 per acre for land covered with trees and bush. The yield is from 600 to 800 lb. per acre. Their own labour is calculated at the value of hired labour. Another estimate is that every 100 lb. of tobacco costs them £2 to £2 10*s*., according to the season. The third quality (fonque) amounts to 50 or 60 lb. per acre, and only gets a very small price.

Both wrapper and filler are purchased together at the same price, which ranges from £3 10*s*. 0*d*. to £4 per 100 lb.

It would therefore appear, from evidence received, that the large grower who has to employ a special manager for his tobacco will have to pay for cultivation and curing, on an average, 9*d*. per lb. for his crop of cured tobacco; the Cuban who looks after his own cultivation and curing may reckon on his crop costing him 6*d*. per lb.

PROSPECT OF THE INDUSTRY.

At present prices, it does not pay large growers to cultivate tobacco and sell the leaf. Even at 1*s*. per lb. there is not sufficient profit to tempt planters to embark in an industry that requires the very closest attention.

Tobacco for Navy. Mr. F. V. Chalmers has been most assiduous in working out a proper blend of tobacco for use in the Navy, and hopes to create a demand for a very large quantity of Jamaica tobacco at 7*d*. per lb. Probably all the best of the third quality (fonque) would answer the purpose, and if so, this price is about double what is usually received for it, and would be a boon to tobacco growers. Tobacco of this quality would, however, only amount perhaps to one-twentieth of the total crop, and could not amount to a large quantity for some years, until the industry is much extended.

Manufacture of Cigars. It would seem that there might be a profitable outlet for planters for their crop if they were to combine the manufacture of cigars with the cultivation.

There are however great difficulties to be overcome, among which are the following:—

(*a*.) To ensure an even grade of cigars it is necessary to have large stocks of tobacco from different localities for blending; so that planters would have to purchase largely, and great judgement, only acquired by long practice, is necessary to select the proper grades of leaf.

(*b*.) To obtain a market for cigars. The local market is already supplied by those who have been in the trade for some years. The general markets in England and elsewhere are at present practically closed against our cigars, which can only be sold by arrangement with private purchasers, such as clubs. No private grower is likely to gain anything but disappointment in efforts to dispose of his cigars.

Sumatra Leaf. If, however, the present experiments in growing wrapper leaf from Sumatra seed, initiated by the Public Gardens Department, be successful on a large scale, the crop would find a ready sale and be profitable.

Extension of the Industry by Small Settlers. There has been a great demand lately for seed, and small settlers are experimenting with tobacco in all parts of the island. It is an excellent product for the small grower, but he should first satisfy himself that he has the right soil and climate, that he can devote himself almost exclusively to it during the months of cultivation and curing, that he can afford to erect a proper curing house, and that he will have a market for the cured product.

ANIMAL INDUSTRY.

INDIAN CATTLE IN JAMAICA.

BY B. S. GOSSET, Jamaica.

The Zebu or humped cattle of India form a distinct species, and are scientifically classed under the title of *Bos indicus*. They are extinct in the original wild condition, but some have broken away from domestication, and exist in a state of nature in the jungles of Northern and Southern India.

Darwin, in his work on *Animals and Plants under Domestication*, says that the Zebu or humped cattle were domesticated as may be seen on the Egytian monuments, at least as early as the twelfth dynasty, i.e., B.C. 2100.

The humped cattle seldom seek shade, and never go into water and stand knee-deep like the cattle of Europe.

The Zebus have been introduced into England and elsewhere and crossed with common cattle. The cross-bred cattle were very fertile. and in Tasmania, where thousands of cross-bred Zebus existed, no instances of sterility have been observed.

The Indian Zebu, popularly called the Brahmin, are generally held sacred by the Hindus, who consider it a sin to kill them, and pollution to partake of their flesh. The bull is worshipped under the name of Nuudee, having formed the vehicle of their deity Siva during his peregrinations: but while a Hindu will, in consequence, starve to death alongside of a fat bull or cow rather than consume its flesh, he will yet partake freely of the milk of the latter.

Cattle in India comprise in most districts the wealth of the agriculturist. The most important object for which these cattle are reared is to provide motive power to cultivate the soil and

to convey by cart produce to market, as well as to yield milk. Their flesh-producing capabilities have hitherto been quite a secondary consideration in their native country.

In form or general appearance and substance, high-bred Indian cattle are, as a rule, inclined to be leggy and rather 'thinly made up.' They carry little flesh, and are in this respect strikingly deficient in the thighs; but in good cattle the ribs are well rounded and deep, and the girth at the heart is good. This remark is intentionally restricted to good cattle, as with the prevailing carelessness in breeding even in the best breeds many specimens have flat, short ribs, and are defective in girth measurement.

The hind quarters are invariably short and drooping, giving to one accustomed to the full, square, and massive quarters of English breeds, an appearance which would, if occurring in one of the English stocks, be immediately classed as a deformity.

The back level is usually straight from the top of the loins till it approaches the top of the shoulders, where it slightly rises and is broken abruptly by a fleshy hump which forms a crest or crown resting on the part corresponding to the withers of a horse. This region in Indian cattle is particularly high, apart altogether from the fact that it is covered by a fleshy prominence.

The hump is a masculine appendage which only comes to full growth when the animal reaches mature age, and when it is in good condition. A diminutive hump is also present on the female in accordance with a general law of nature.

The flesh of which the hump consists is excellent food, and is considered to be a delicacy. It is eaten fresh, and is also corned. I have eaten it in the latter condition: it resembles and tastes much like the base or root portion of an ox tongue. Throughout the rather stringy, open-grained, fleshy substance there is an admixture of fat.

The hump is erroneously supposed to have something to do with the drawing power of an animal; but its fleshy composition and its position quite above the neck on which the yoke rests put such an idea out of the question. Indirectly, no doubt, a large hump is generally indicative of power, as a well developed and muscular neck may usually be correlated with the well-developed hump. A sudden droop occurs in the upper neck at the point where it joins on to the trunk. It is in this depression that the yoke is placed, by which the steer is enabled to apply its strength in pulling. In Jamaica, on the banana and tobacco plantations, the Cuban yoke, secured by ropes or thongs to the forehead, round the horns, is now chiefly used, a pad or folded bag being placed under the yoke and at the back of the horns to prevent cutting and bruising.

The ears are usually, but not invariably, large, and more or less drooping. They seem to hang in a position where it would take little exertion to move them; when they are in motion they swing forward so as momentarily to cover the

eyes, and thereby flap away the flies that are abundant in the hot climate.

A deep dewlap, extending from the chin backwards between the forelegs, is, next to the hump, the most striking characteristic of Indian cattle. It varies in size with the different breeds.

Colour of hair.--Indian cattle, taken as a race and represented by pure-bred specimens of the different strains, are what may be termed whole-coloured, in contradistinction to broken-coloured. By whole-coloured is not meant that an animal is all of a uniform colour, but that in the changes of colour from that of one part to that of another part there is no distinct break or division line—the colours shade or merge into one another. The most common colour is white, or very light grey of various shades, the two colours blending harmoniously.

The bull of mature years is usually darker than the cow or young bull. After castration, steers turn a much lighter colour, and therefore the distinction of colour is hardly recognizable.

Where broken or patchy colours appear, they, with few exceptions, indicate cross-breeding of more or less recent date. Few of these animals which are termed whole-coloured are altogether free from black hairs: there is usually a fringe of black, or brown, round the hoof heads, and frequently patches on the joints above the pasterns.

The tuft of long hair at the point of the tail is rarely white, and there are often dark markings about the ears, with black hoofs, black muzzles, and black eyes, while the colour of the skin within the ear, though dark, is often of a lighter shade than the body skin. Frequently the tint is orange, with dark longitudinal patches through it.

Colour of skins.—Perhaps the most interesting and remarkable peculiarity connected with Indian cattle, is the fact that, however white the hair is, all but a very small percentage have jet-black skins underneath. Less than 1 per cent. have white or light-coloured skins, like most English cattle, but these are considered to be soft and weakly. There is little doubt that the black skin is in some manner connected with the ability of Indian cattle to work in the sun without suffering as light-skinned cattle do.

Temper and Disposition. Indian cattle are said to be impatient in India in the presence of strangers, while perfectly docile and amenable to treatment with their usual attendants.

Those imported direct from India to this island were very tame, the first Mysore bulls allowing themselves to be mounted and ridden by the penkeepers. The Gugerat bulls were also very tame, the bulls being almost invariably tamer than the cows. The cross-bred descendants are wild and timid, more especially the Gugerat crosses: they have had little or no handling before being put to work, which may account in some measure for their wildness, but at any time, the disposition of cross-breds is to be wilder than pure-breds.

The first pure-bred Hissar cattle from Trinidad were also very tame, more so than most ordinary cattle. They seem to take as readily to strangers as to any one else. The pure-bred

Hissar bulls at Home Castle were oppressively tame, frequently following visitors all over the pen and rubbing their heads against one, while the cows and heifers were rather restless and shy. The tameness of the bulls may result from good treatment and care in their management, as their half-bred calves were timid and shy, probably not having received the same attention. It is a well known fact with English cattle, that cross-breds are wilder than pure-breds.

The horns of the different breeds are exceedingly variable in shape and size, and also in the direction in which they incline after leaving the frontal bone. In animals bred under the hand of nature there is a strong tendency to uniformity of type, not only in the colour but also in the shape of the horn, and, I might fitly add, in general characteristics. The greater variety and sports among domestic cattle, generally show the results of human effort to attain certain ends.

The size of the animal is dependent mainly, as is the case in all parts of the world, on the amount and quality of available food. Various other characters, some seen, and some unseen, are dependent upon local conditions. For example, cattle reared for generations on hard soils of a poor stamp have usually flinty and durable feet of handsome form and moderate dimensions, while cattle bred on rich and deep land have soft and tender feet.

We have an example of increase in size in the cross-breds and almost pure Mysore cattle at Shettlewood. They are much larger than those which were originally imported.

In voice, Indian cattle differ as much from the European races, as in any other particular. In place of the ringing bellow and whoop of the English and other bulls in which both lungs and throat play an important part, giving bellow after bellow until the distant rocks and woods echo and re-echo, and if possible, clarify and accentuate the sound, there is but a hoarse guttural grunt or half-cough thrown down to the earth. In the female this form of bovine utterance precludes the smallest possibility of rousing those feelings of sentiment which are associated with the lowing of a cow. The peculiar sound rather gives one the impression at first that there is something wrong with the animal.

BREEDS OF INDIAN CATTLE.

It is only intended to describe the breeds of Indian cattle that have already been introduced into this island, and which have stood the test of climate, feeding, work, etc.

The first Indian cattle were sent out to Shettlewood Pen more than half a century ago by the late Lord Howard deWalden.

There is no record of what breed they were, but tradition says they were given by the King of Portugal to Lord Howard deWalden when he was Ambassador at Lisbon. They had come, therefore, probably from the Portuguese settlement of Goa. It is said that they had been crossed with Portuguese

cattle, but this is very doubtful. The breed has been always noted as workers, and as being much hardier than ordinary creole cattle.

The stock from this strain have been spread over many of the pens in the northern and western parts of the island, and have done much to improve the working qualities of the cattle of those districts.

MYSORES.

In September 1880, five pure-bred Mysore cattle were sent out by Lady Howard deWalden to Shettlewood Pen. These comprised two bulls, two cows, and a bull-calf born on the voyage. These cattle were, I believe, selected from the herd of the Rajah of Mysore, and were of the purest strain. the breed having come to its greatest perfection under the native rulers

A further importation of several pure-bred Mysore bulls has been made by the Hon. Evelyn Ellis, the present proprietor of Shettlewood, who went himself to Mysore and stayed for some months in the country so as to select some of the best from the Rajah's herd.

They were, I believe, of what is known as the Amrit Mahal breed, which is supposed by some to mean palace milkers. Being kept for that purpose and for supplying steers for draught animals, these have the reputation of being the handsomest, best known, and most largely represented breed. The chief centre at present is the Huusur Grazing Farm of the Madras Government.

The distinguishing features of the Amrit Mahal breed of Mysore cattle, may be gathered from the following description by Professor Wallace :—

'The head is long and tapering towards the muzzle, which is generally black. The forehead bulges out beyond the line of the elongated nose like the foreheads of many young calves of other breeds.

'The horns are set well back on the crest of the frontal bone; they spring close together like the horns of a goat, then diverge and incline backwards each in a straight line for fully half the length, when with a gentle and peaceful curve they bend upwards and usually slightly inwards towards their terminations, which are black-tipped, and exceedingly sharp. At times when the head is down, as when feeding, the horns touch or almost touch the neck in front of the hump. They thicken gradually as the head is approached, and are very strong near the base which seem to extend, apparently to give strength, down the forehead between the eyes, as a distinct ridge on each side, thus forming a perpendicular groove or depression in the centre of the forehead. The peculiar setting on of the horns with the skin and hair covering them up a little way above the actual root makes the head appear longer than it really is.

'The eyes are quick, but not large or prominent; they are usually black, but at times they have a red or bloodshot look about them.

'The ears are yellow within, neat and short for cattle of the size, and taper rapidly from a good breadth to a sharp point; they project at about right angles from the cheek.

'The tail is nicely formed and tapers like a whiplash to the black terminal tuft of hair.

'The hump and dewlap are both well developed.

'The back line is straight from the shoulder to the loins where it droops.

'The hoofs are small, hard, and well formed.

'The ribs are well rounded and deep, yet the belly is not too large to interfere with active work.

'The shoulders are remarkably neat, and the bones of the leg fine, flat, clean, and race-horse-like. On account of the bones, the muscular forearm does not appear massive in proportion to its actual strength.'

The breed, as a whole, occupies among cattle a position for form, temper, and endurance, strongly analogous to that of the thorough-bred horse among horses. The animals representing it are light in build, and their greatest defect is their moderate size. This, however, has been improved by crossing them with the larger creole cows, and the cross-bred Mysore steers are, when fully grown, just as large as ordinary cattle. The cross-bred bulls, though short-legged, are in most cases quite as heavy as creole bulls, though inferior in size and weight to cross-bred Hissar bulls.

As workers, the cross-bred steers are excellent and can, with care, do twice as much work as ordinary cattle.

As milkers, the cows are notorious for their poor yield. It is a common tendency in all breeds for the milking qualities to degenerate when calves suck in a state of nature as when cattle go in herds.

In India, a cow of this breed is supposed to give about 1 quart of milk a day, and the calf could not be deprived of any part of it without being materially injured in its growth. The calves remain with their mothers during the day, but are kept in a fold under charge of the herdsman until they are three months old, when they begin to graze and get strength.

In the cold season when herbage is abundant they are generally weaned at the age of five months; but such as are born later in the year cannot be separated from their mothers till after the hot weather.

In this country, the calves are kept with their mothers day and night in the pastures when the cows are not being milked and are not generally weaned till they are about nine or ten months old.

The cross-bred Mysore calves are most difficult to wean, as they are very active and when placed in separate pastures to be weaned, will jump ordinary stone walls and force their way through even barb-wire fences in a most incredible manner to get back to their mothers, or to the particular pasture or companions they are used to.

In India, heifers begin to breed between three and a half to four years old, and produce about six or seven calves, which is much the same as ordinary cattle do here.

I have noticed that cases of heifers breeding at two years old or having calves at three years old are very rare, especially among the higher-bred Zebus.

Once the cows have started to breed they are much more regular breeders than cattle of ordinary, or of mixed English breeds: this more refers to half-breds; the grades from three-quarter-breds upwards mostly give a calf every other year.

In India, twenty cows are allowed to one bull, which is rather more than the proportion to a bull in this country. The bulls in India are not used till they are five years old, while three years, or often two years, is considered old enough on Jamaica pens.

The average annual percentage of calves in India is 50 per cent. This is below the average increase in Jamaica, which is from 60 to 80 per cent.

The steers are separated from the herds when four years of age and transferred to the Public Cattle Department when turned five, perfectly trained and fit for work. They arrive at their full strength at seven, and are past their vigour at twelve; they work to fourteen or fifteen, after which they decline rapidly, and generally die at eighteen years of age. In Jamaica some of the imported Mysores lived on to the age of twenty-two, and I have heard of cows calving when well over twenty. As a rule in Jamaica, cows are transferred to fatten at from ten to eleven and sold off fat at eleven or twelve years old, before they are much past their vigour.

The system of weaning calves in India at five months old may account for the very considerable increase in size of the Mysore pure-bred and half-bred, since their introduction into the island, where they are allowed to run with their mothers till the mother has another calf and weans the yearling herself.

THE GUGERAT BREED.

There are two varieties of the Gugerat, or as they are sometimes called here, the Kathiawar breed (though this name more properly belongs to the Gir cattle), the large and the small. Those that have been introduced into Jamaica seem to be all of the large breed, which Wallace describes as decidedly the finest of all the large cattle of North-western India for massiveness, and various accompanying good qualities. It is only equalled by those from the banks of the Upper Kistna, which by Dr. Shortt are considered to be of the same variety as the Nellore.

A good specimen of a Gugerat steer stood 5 feet 7 inches to the top of the hump, and had a girth of 6 feet.

This breed may be described as white with black points: the white, however, often assumes a bluish tint in the cows, more particularly about the head. Many of the bulls are decidedly grey, and frequently of a darker shade on the hind and fore quarters and head.

The horns, which are sound and of a good medium size, project upwards without inclination either to the back or front. They are however, more or less of a rounded bow shape ; curving at first outwards as they leave the crown, then inwards, and slightly twisting as they approach the tips.

The dewlap in the male is well developed.

The ears are large and pendant.

The trunk is, as it ought to be, compact and well knit, and with a good depth about the region of the heart. The shoulders are fine, and joined on to the neck in graceful and symmetrical lines, and are adorned in the male by a specially well-developed hump. Though the body is large and of good form, the qualities most to be appreciated in the Gugerat breed are to be found in the powerful and well-shaped limbs, and the black-hoofed feet, possessed of an unusual degree of hardness and durability for large cattle.

In 1885, four pure-bred Gugerat cattle were imported for Shettlewood pen, consisting of two bulls and two cows ; one of the cows died after arrival from injuries received on the voyage. The cross between these and the Mysore adds size to the latter, and the cross with native cows is larger than the Mysore cross.

The Gugerat are more timid and less tractable than the Mysores, but are equally good workers, and quite as hardy. In India, they are said to be of a mild disposition, and of good temper, but this has not been my experience with those I have had the handling of, which have proved to be, though excellent breeders, and when broken in, good milkers, the most wild and intractable of all the cross-breeds I have handled. Mr. Charles Nunes imported a fine pure-bred Gugerat bull from Trinidad, whose descendants have been dispersed over many parts of the island. I have also had cross-breds from the Shettlewood strain which show much the same disposition. One cow of this breed gave twelve calves and was regularly milked for years, but was never of a docile disposition.

The imported Gugerat stock were all very tame and easily handled, but the cross-bred stock from them were decidedly wild and high-spirited. The unbroken steers are most difficult to move off the property they have been raised on, and give considerable trouble to deliver to estates at a distance; but, when once put to work, take kindly to it, and are in great request among planters for cart work on estates.

Like the Mysore, the Gugerat steers will live and thrive on the shortest bite, on which other cattle starve and die, the mortality among them being very small even in the driest seasons.

Planters consider that they will do twice the work of ordinary cattle on less feeding.

THE GIR BREED.

The Gir breed, from the neighbourhood of the Gir forests in Kathiawar, is of a special type, quite different from the

ordinary run of Indian cattle. It is sometimes called the Kathiawar, Broach, Surat, or Gugerat breed.

The ears are long and quite pendant, like the ears of the lop-eared rabbit. They are somewhat peculiar: the points incline inwards and the sides coil well round, giving the ear a sort of bell-like form.

The head is short, neat, and well-shaped, the forehead being particularly broad and prominent. It is made to look all the more so by the backward inclination of the horns, which in the male, though short, are thick, flattened, and crumpled in a peculiar way, so as to resemble somewhat the horns of a bison.

The horns of the female are considerably thinner, but black in colour like those of the male.

The eyes are black with a mild expression; they are shaded by a heavy upper eyelid.

In the matter of depth of dewlap and sheath, the Gir rivals the Nellore breed. The cows are, like the Nellore, also noted for their milking powers, supplying most of Western India with milch cattle.

The common colour of the bull is a dark brown, with the greatest depth of colour at the points of the extremities. The tail is thinnish, and is terminated by a bushy black brush of hair. Some cattle of this breed are white, with more or less brown on the legs and inside the ears. Frequently, in addition, there are brown patches or spots on the head and neck; these may also appear on the body. The brown variety is considered to be the best type of animal. No doubt the spots have crept in by cross-breeding in the past.

The refinement of parts, peculiarity of type, and fixity of character, show that considerable care has at one time been bestowed on the management of this breed of cattle. There is a tradition that they were imported from the west. The marked difference in some particular points, as compared with Indian cattle generally, would incline one to this view.

In January 1890, two Gir bulls were imported from India to Shettlewood Pen. They were described as particularly docile, and they have doubtless produced valuable cross-breds.

THE HISSAR BREED.

This breed comes from the Hissar and Hansi districts in the north-west Province of India, and are favourably thought of. They stand from 56 to 64 inches high; their heads are broad, necks short, humps high, hips broad, and hind quarters square; they carry their heads erect and have short stumps of horns; they are of great substance and have long bodies, deep wide chests and massive but rather short legs, fairly apart to support the carcass. The steers are very large and strong, and draw great weights and heavy ploughs, but are not so fast as steers of some other breeds. They are generally of a nice white colour, but sometimes red, black, brown, or piebald ones are found.

The cows give from 10 to 16 quarts of milk in the twenty-four hours, but when removed from good pasturage the milk somewhat decreases.

The bulls are used in many parts of India by rich farmers to improve the local breeds of cattle, and are let loose as Brahmin bulls. These animals roam about all over the country and the settlers are allowed their services free.

The Hissar breed seem to be quite the leading breed in India for milking purposes. A cow of this breed has been recorded as giving 4,000 quarts of milk in a year, or an average of about 11 quarts daily. This compares favourably with the yield of many English cows. These cattle were introduced from India to Trinidad, and it is due to the enterprise of the Government at Trinidad, that the Hissar breed has been distributed all over Jamaica. Their descendants now form the bulk of the cattle of Indian strain in the island.

THE VALUE OF INDIAN CATTLE.

FOR DRAUGHT.

Of the four different breeds of hump or Zebu cattle that have been introduced into this island, the Hissar will, for general utility purposes, probably prove the most useful breed, as these combine good working qualities for slow work with the best milking qualities.

The Mysores have been thoroughly tested as to their suitability for estate work. They are matchless for road work and are largely used in the banana districts in place of mules to take bananas to shipping places with spring carts.

A well known planter of wide experience, speaking of Mysore grades of cattle as to the working qualities, said that taking all the year round, one steer is equal to two creoles. They never go lame, nor get sick. The Indians seem to thrive and look well on the shortest of bites when the creole hangs his head and goes to skin and bone.

He states: 'I have no doubt, if put to the test, the hauling power of the Mysore is much more than those of the creole, but for cart work the same number of both is used as a rule. In the plough we can use ten Mysores instead of twelve creoles. The great beauty of these cattle is, they are hearty feeders and always in good working condition: never sick nor lame.'

Evidence like this settles the fact that Indian cattle surpass all others as workers, and are best suited for all classes of work.

HARDINESS AND SUITABILITY TO CLIMATE.

Indian cattle are noted for their hardiness of constitution; they can subsist and keep in good condition on the shortest bite, on which creole or English-bred stock would starve and die; they eat many of the coarser grasses and shrubs that other cattle refuse, and are free from most diseases. They thrive equally well in the hottest lowlands or in the highest moun-

tains; neither excessive drought nor excessive rainfall seems to hurt them.

They are in a great measure immune from the attacks of the different species of ticks, which swarm in our pastures. I have noticed a great diminution of ticks in pastures which have been regularly fed by Zebu cattle, and horses also thrive better when fed in the same pastures as Indian cattle. Ticks are frequently on the skins of Zebus, but unless the animal is sick or is starved, they do not seem to thrive, but appear rather to exist in an undeveloped state. Should the Zebu be starved for a couple of days, the ticks develop on its hide in a most astonishing way, though the animal may have been confined in a place where there were none.

In times of drought they can be driven considerable distances to water, a proceeding that often causes heavy losses on pens in dry seasons in some districts. They are able to do without shade, and thrive in the most exposed situations under a tropical sun which causes the hair of cattle with English blood in them to stare and become tender to the touch, and in fact to become sunburnt.

The chief causes of loss by disease, are blackleg among the young stock, and splenic fever among the older ones. These diseases often take the very finest and best of the growing cattle, but splenic seldom attacks mature beasts, and only young animals are subject to blackleg.

MILKING QUALITIES OF INDIAN CATTLE

The Mysore cattle are doubtless poor milkers: the very qualities which place them at the head of the working breeds of cattle are against their giving much milk.

On the other hand, the Gir cattle are famous as milkers, and rival the Nellore and Hissar, which are reputed to be the best milkers in India.

I have no records of the yield of milk of Indian cattle in Jamaica as they are generally kept for breeding working stock and have not been extensively used for dairy purposes.

The cows are somewhat difficult to break in to milk, and frequently are so restive that they have to be thrown to the ground and, for a week or so, milked when in this position. They mostly object to being tied when milked. When once broken to milk, they are better to milk when free and unconfined.

MEAT-PRODUCING QUALITIES OF INDIAN CATTLE.

Indian cattle have never been valued for those flesh-producing capabilities which form such an important feature in most of our local breeds of cattle. This, however, does not prevent half-bred Indian stock from producing very good beef. There is some prejudice against the beef of Indian cattle that have been worked for years on estates, many of which when killed are often fourteen or fifteen years old, and are somewhat tough. Overseers of estates are loath to draft their best old Zebu steers, which are often kept on at work long after creole

those on estates can be put down as mules; and of the 30,000 working on the roads, at least four-fifths are also probably mules and donkeys, leaving about 6,000 horses as our number of horses in actual use. Of the 17,000 head of horse-kind on pens, 10,000 are perhaps horses and the rest young mules and donkeys; and of the 10,000, probably about 3,500 are brood mares. These figures may, on analysis, be taken to represent that there are about 3,500 brood mares; about 7,000 young horses foals, yearlings, and two-year-olds; about 7,000 young mules: about 7,000 mules on estates; about 6,000 horses working on the roads; and about 24,000 mules and donkeys working on the roads.

Our best breeding centres are in St. Elizabeth and in St. Ann, but plenty of horses are bred chiefly by small settlers, in Manchester, Trelawney, St. James, Hanover, Westmoreland, Clarendon, and St. Catherine.

St. Elizabeth is the home of horse breeding in this island; and it would have been interesting if a visit could have been paid to the Pedro District to see the fine type of horse which the small settlers there possess, and to observe the care and attention that is bestowed upon their stock.

A visitor to Jamaica at once notices the distinct type of Jamaica horses. That type is the thorough-bred, degenerate and mean-looking in many cases, but still the thorough bred. These horses can do a considerable quantity of work on a very small amount of food and, when well fed and well cared, make splendid riding animals and polo ponies. I ascribe these attributes to the large preponderance of thorough-bred blood in all our horses.

The importation of thorough-bred horses from England to Jamaica began in the year 1752, when the first record which I can find in the *English Stock Book* is a horse called Captain, who is recorded as having been sent to Jamaica. I have in my possession an interesting volume in which I have recorded the pedigree of every horse that has ever come to, or been bred in, Jamaica, and from this I gather that from the year 1752 up to the present time, there have been imported into Jamaica from England 190 thorough-bred stallions and eighty mares, the larger proportion of which left progeny of some kind. It is interesting to note that in the early part of the nineteenth century we harboured in Jamaica a Derby winner in Hannibal, who won that race in 1804 and was imported to Goshen in St. Elizabeth. We also had at Pepper, in the same parish, what was then the largest stud of thorough-breds in the world, consisting of 100 thorough-bred mares and seven imported stallions.

Thorough bred blood seems to be the only strain of blood which thrives well in Jamaica, and which has been able to survive the test of time. Heavier and coarser breeds have been tried, but they have all proved failures.

Horses in Jamaica are required for saddle work, drawing light carriages and buggies, polo, and racing.

The horses which are not good enough for racing or polo suit admirably for carriage horses and saddle work. It is the aim of our breeding, therefore, to produce race horses and polo ponies. I will try to point out the position of horse breeding in Jamaica to-day, and its prospects.

The horse-breeding industry in Jamaica is one of our most important and general industries, and is perhaps one of our most valuable assets. Jamaica stands in relation to the West Indies, as regards horses, in the same position that England does to the rest of the world: she is the stud farm of the West Indies. Other islands breed horses of sorts, but they are unable to breed such a cheap and marketable animal.

Jamaica produces large numbers of good horses and mules, but, unfortunately, a considerable quantity of bad ones are also produced. It might, therefore, be suggested that if some attention were paid by the Government to this question, the proportion of bad ones could be greatly reduced. By making it a penal offence, involving a heavy fine, for any person to keep an entire horse which is not licensed and approved of by the Government, would go far towards securing this end, and if a stud farm were instituted where a number of stallions could be kept for distribution all over the island during the covering season at a nominal fee or even free, it might be possible that in a few years there would be a marked improvement in the horses bred in Jamaica, especially among the poorer classes.

At no period in the history of Jamaica have we stood in a better position than we do to-day as to the possibilities of an export trade. We have always been able to produce horses, but we have never had certain markets or shipping facilities. At no time has the local demand for horses and mules been better. All over the West Indies the Jamaica horse is preferred to any other for general utility purposes. He is easier and cheaper to keep, he is sounder and lasts longer. The Jamaica mule has established a reputation in Cuba and the Canal Zone, and the inquiries for them are now frequent. On the Isthmus I am told that the authorities have realized that the small wiry Jamaica mule can do as much work, and stands the climate better than the big Americans, and that the demand for Jamaica mules will continue so long as there is work to do on the Canal Zone.

But perhaps the brightest future which is in store for our Jamaica horses lies in the production and exportation of polo ponies. The market for polo ponies in England and America is practically unlimited. Jamaica can and does produce a first-class animal for polo purposes, and it is doubtful whether it can be produced cheaper and better elsewhere. Polo ponies can be produced and sold at a profit at £25 each. These ponies should stand quite 14·2 hands and should be capable of carrying weight. Animals of this stamp are good for all purposes, and mares of this sort make better brood mares than big, leggy ones.

In dealing with the question of breeding mules, the most important factors are the donkeys and brood mares used. As regards the latter, an improvement will take place so soon as

some attention is given to the horse-breeding industry; and as regards the donkeys, this, too, is one of the questions which might profitably receive the attention of the Government. More stallion donkeys of a first-class type are sadly needed in the country, and these should be put within the reach of small settlers and poorer classes.

The enormous increase in the tourist trade during the last few years has created a demand for buggy horses and travelling ponies which is already becoming difficult to supply. Polo is a game which has been stimulated recently by the interchange of visits between intercolonial teams, and there is, in consequence, a good demand locally for polo ponies, and the demand for horses for racing purposes would also appear to be on the increase.

I have endeavoured to lay before you as briefly as possible, what appears to me to be the position and prospects of our horse-breeding industry in Jamaica. I trust that I have succeeded in impressing our visitors with the fact that Jamaica is capable of supplying large numbers of first-class horses, and it is hoped that the Government may see their way towards assisting in furthering and improving the horse-breeding industry.

DAIRYING IN JAMAICA.

BY T. P. LEYDEN, Jamaica.

The subject of dairying in Jamaica has been receiving a good deal of attention during the past three or four years, and it is proposed to offer a few suggestions to the inexperienced investor that will enable him, should he desire to attempt dairying, to make a start on sound lines, and to assist him in building up what ought to be one of the most lucrative sources of income in the island.

THE KIND OF PROPERTY TO LEASE OR PURCHASE.

An investor who is only possessed of a small capital, say, £500, should only lease a property with the option of purchase, and in selecting it, the following essential facts should be observed :—

1. The property should be well sub-divided, containing a fair proportion of Guinea grass.

2. The pasture should radiate to the central milking pen, or should be so placed that it can be made to do so, at a small cost.

3. A good source of drinking water should be obtainable for the stock, by tank or spring, in the milking pen.

4. The property should be fairly situated as to the railway station or the creamery to which the milk or cream is intended to be sent.

5. Portions of the land capable of being ploughed should be present at no great distance from the milking pen.

In many parts of the island it will be impossible to obtain all these conditions, but an effort should be made to select a property with as many of them as possible, especially that with reference to the land capable of being ploughed.

STOCK AND IMPLEMENTS REQUIRED TO COMMENCE WITH.

The question of the laying out of capital is the next to be considered, and in order that a concise example may be taken, I shall consider the case where the property selected can carry a given quantity of stock, say, sixty head, under the conditions as it stands on leasing.

Purchase twenty ordinary Jamaica heifers, not older than three years, and to calve about March or April following. For these you will have to pay, say, £8 10s. per head, and say, £20 for a bull of whatever milking strain you select.

Erect in your milking pen a stable, and sub-divide it into six stalls, each about 7 feet square, having three stalls on either side, with a passage way of 6 feet down the centre. The sides to windward should be boarded to prevent rain beating in. In one of these stalls a table should be fixed about 4 feet high for your milk receptacles, and adjacent to the table a small spring balance scale on which the milk taken from each cow is

weighed and entered on a form placed handily for the purpose. To the inexperienced, the weighing of the milk may seem a great trouble, but it is one of the only ways to ascertain which are the most profitable cows and which are not.

The milking pen should be fairly close to your residence for convenience, and about 100 yards away from the milking pen, erect calf stalls, making a small stall for each calf. These may be 4 feet wide and 6 feet long, and should be arranged so that the calves cannot get at each other, and that the man who feeds them can get to each calf without having to pass through a stall. A passage way would be convenient.

At the end of the passage way, erect a room for the separator, so that as soon as the milk has passed through the separator, it can be fed warm and sweet to the calves. The convenience of being able to get to each calf separately will then be felt.

The building of the cow stalls and calf stalls should not exceed £20 each, and say, a further £15 for the separator room, will take £55 of your capital. A separator costing about £15 will be required, and such things as a plough, cultivator, grass cutter, harness for mules, a manure cart, spades, forks, etc., would take a further £40. Two mules will also be required and a good serviceable pair could be obtained for about £30. Therefore, to summarize :—

Cost of cattle, with bull	£190
Milking stalls (£20) ; calf stalls (£20) ...	40
Separator room	15
Separator and utensils	40
Two mules	30
	£315

This represents the amount of capital to be outlayed at the beginning. The balance of the £500 should be held in reserve for meeting expenses, until the heifers purchased commence to give some return in milk.

HOW TO COMMENCE MILKING OPERATIONS.

The first thing to be considered is the number of labourers to be employed. A knowledge of milking must first be acquired, for then it will be possible to supervise and instruct the employees. As the cattle purchased are only ordinary Jamaica stock, bad milking will not affect them as much as if they were heavy milkers from good milch strains. Each milker should be carefully watched and instructed as to his chief faults. With patience and careful handling it should be possible to possess some competent and proficient men. Always watch to see whether each milker strips the cows, i.e., takes every drop of milk from the udder. The last few drops are the rich milk and tell in the separator. Besides, it ensures three things ; firstly, that the quality of the milk will be better ; secondly, that the cows will not dry so quickly ; and thirdly, that the milking capactiy of the cows will be developed.

The next thing to receive consideration is how to break your cow to milk without the calf sucking. For cows that have already suckled two or three calves, and for those with their first calves, the following method may be recommended: Let the calf run with its mother for one week. Every morning and every evening during that week, strip the cow's udder after the calf has sucked its full. At the end of a week, take away the calf in the evening and lock it up securely. The next morning, muzzle the calf and bring it to its mother, in order to allow it to touch alongside her. The cow, on seeing its calf, will send down her milk, which the milker then draws from the udder. Probably the cow will be unwilling to allow all the milk to come down at once. In this case, let the calf's head touch the udder. In a short time the cow will allow the milk to flow.

When the cow is fully milked, place some of the milk in a small bucket, and take the calf, unmuzzle it, and place its head between your knees and, putting one finger in its mouth, gradually bring its head down until it touches the milk in the bucket, and try and get a little of the milk into its mouth. The calf will probably start sucking your finger, and in that way get some of the milk; but if it will not suck, lock it up again, until evening, when you again bring it down to its mother, and the same process of milking the cow and feeding the calf takes place. It is very seldom that a calf refuses to suck up the milk again in the evening.

In the case of a cow that has suckled two or three calves, you can, after a few days of the above process, place the calf in a stall next to her, and, on seeing her calf, she will let down her milk without any further trouble. But in the case of a cow with her first calf, two days, or four milkings should be sufficient for the mother to see her calf. If the cow is obstinate you must go to the trouble of bringing down the calf a few times more.

It is always advisable when you are going to try to milk a cow for the first time without her calf, to see that the calf is muzzled and cannot answer her if she bellows, and also that there are no young calves of the same age about. Treat the cow kindly: do not rough it, or frighten it; be patient if she does not do what you require of her at once.

HOW TO REAR CALVES.

How to rear calves by hand economically is an experiment being tried by many, and a cheap, and at the same time a very successful way, is as follows:—

For the first week after taking it away from its mother, give it 2 quarts of good or whole milk, morning and evening, adding at first, one pint of skim milk and gradually increasing the quantity of skim milk until, at the end of the first week, the calf is getting 2 quarts of good or whole milk and 1 quart of skim milk at each feed. Then gradually commence to decrease the good milk, increasing the skim milk proportionately, so that the calf still gets the 3 quarts at each feed.

At the end of two weeks more, that is, when the calf is four weeks old, it should get the last of the whole milk.

When the whole milk is stopped, it is advisable to commence giving it a little calf-meal twice a day—just a couple of small pinches at each feed. This meal should be given dry, and about one hour before the calf gets its milk feed. Gradually increase the meal feed in quantity, and after a month, that is, when the calf is two months old, add a little corn meal and bran. As the calf gets older, increase the feed of corn meal and bran and decrease the quantity of calf-meal so that, by the time the calf is three months old, it should be getting 1 quart of corn meal and bran at each feed, and no calf-meal. At three months of age you can also increase the feed of skim milk, if it does not make the calf scour, until the calf gets 5 quarts morning and evening. If the calf scours, reduce the milk feed back to what it was. Continue the milk feed as long as possible, and when milk is running short, gradually reduce the quantity. Always feed your calf in a stable, and break it in in such a way that when it starts milking, you will have an animal thoroughly broken.

One of the most frequent complaints with hand-reared calves is worms. You notice the calf has a light yellow purge, and its skin becomes rough. A good remedy is 15 drops of laudanum with 2 table-spoons full of whisky in a little water, given after a fast of about twelve hours. Repeat the dose if necessary the following day. The calf should be placed by itself, in a closed place, firstly, to keep it from the healthy calves, and secondly, to ascertain whether the medicine has had the desired effect. If the medicine has had effect, destroy the excrement and purify the stable. Always remember to keep unhealthy calves away from the healthy ones, and keep all the feeding utensils clean.

Calves reared as above should not cost more than £3 each, when twelve months old, exclusive of the skim milk and whole milk that they have drunk.

In hand-rearing calves from ordinary Jamaica cows, it is advisable only to rear one calf to every three cows calving for the first time, and only one calf to every two cows calving for the second and third time. It is also to be recommended that the calves reared should be heifers, for they will be valuable in the dairy at a future date. Jamaica cows when milking after their first calf do not give a large quantity of milk, so that if one calf is reared for every cow, when they attain the age of three months you will find that when you share round the milk to a large number of calves, each calf will be getting a small quantity, and unless you are prepared to feed very heavily with grain, miserable animals will be obtained. At first, especially, only attempt to rear a few, and should you not succeed, you will have the satisfaction of knowing you have not expended very much money in the attempt.

THE PROFITS ARISING FROM DAIRYING.

If your heifers calve during the month of March, April, and May, they should yield at their first milking, valuing the

milk at 8*d*. per gallon, about £5 for a milking period of, say, nine months. If they calve during the fall of the year, they will not yield more than £3 during a milking period, unless by good fortune you get a very short dry-weather season. This is why I recommend getting your cows to calve early in the year. Your cows milking for the second time should yield at least £8 a year, and for the third time £10 a year. Therefore, the twenty heifers in the first year would only yield about £100. Out of this would have to be taken all the expenses, and, consequently, little would be left to pay living expenses. In the third year, the income should be doubled and a careful man would be able to have enough out of his small surplus capital to purchase a yearling now and then, and with the calves reared annually, an investor, in seven years, should have his pen fully stocked with his sixty milkers, which in their various ages of milking he could safely reckon, taking the gallon of milk at 8*d*., to average £8 10*s*. per annum each milker, or £510 gross a year. The expenses inclusive of everything would not exceed £150 per annum, so that there would be a net profit of at least £360 a year. There will be a further profit from the sales of broken heifers and cows, and it would be safe to say that from sixty cows an investor should have at least twenty head to sell every year. A conservative price for these should average £8 10*s*. per head, so that a further £170 should be added to the income, bringing it up to £530 per annum.

I stated, in the first instance, that the property selected was supposed to carry sixty head, and it might be suggested, if you have sixty cows how are the yearlings and two-year-olds to be fed. That is where the plough and the manure cart come in. The first spring you are on the property, put in ½ acre of canes, the first autumn put in another ½ acre of canes. Also plant an acre of bananas, and put in 1 acre of corn. Calves should be taught to eat all these three foods, as well as corn meal and bran. Cut-grass should also be placed in the stalls, so that as they take their place in the dairy, they will readily eat all these three feeds. Each year, increase your field of bananas, canes, and corn to meet increased demand of feeding, and it should be found that the enormous amount of fodder contained in a few acres of canes, bananas, and corn will more than meet the increased quantity of stock. Again, when you have fed your pasture in the ordinary way, run your grass cutter over it. The grass cut will form a splendid manure, and enable your grass to spring quicker and be ready for feeding again much sooner than if left in the ordinary manner.

In conclusion, I may state that the investor, to succeed in dairying, must be hard-working, economical, and persevering. He must not be afraid to soil his hands with hard work, and no detail must be overlooked. The work, although exacting, soon becomes interesting, and if his tastes lie in an outdoor life, he will find few occupations that are at the same time so absorbing and yet so profitable.

AGRICULTURAL CREDIT AND LOAN BANKS.

THE CHRISTIANA PEOPLE'S CO-OPERATIVE BANK, LIMITED.

BY THE REV. WM. T. TURNER, Jamaica.

The introduction of People's Banks into Jamaica is due to J. T. Palache, Agricultural Instructor for the parish of Manchester, who wrote a series of articles in one of the local newspapers on the subject of Agricultural Loan Banks, dealing specially with the Raiffeisen system of 'rural loan banks' which was started in Germany about fifty-five years ago. He also outlined a scheme for a loan bank which, in his opinion, was suited to the conditions of Jamaica. These articles attracted a good deal of attention, and were afterwards published in pamphlet form and circulated in the island, chiefly in the parish of Manchester.

Mr. Palache followed up his articles by expounding the system to the various branches of the Jamaica Agricultural Society in Manchester, and advocated the adoption of these banks as an aid to the peasant class of the population.

The history of the growth of this system in Germany where it originated, in other countries in Europe, in Britain, and more recently in Canada, may be said to have been very remarkable, when there is taken into consideration its very small beginning, and its slow progress at the commencement. There are at present some 28,000 of these banks in Europe alone, although the third bank was not established until twenty-three years after the first one was opened. When the opposition the system aroused in some quarters, the very searching inquiries that were made by a Royal Commission, and the rapid strides the system made after the Commission had reported, are taken into consideration, the soundness of the principle on which these banks are founded cannot be questioned. The success of these banks, in every country into which they have been introduced, diverse as the conditions pertaining in these countries are, strengthens the conviction that the system is one that should succeed in Jamaica, especially seeing, as Mr. Palache has pointed out, that the circumstances and conditions of the peasantry of the island are just such as these banks have been found most fitted to help.

The people are poor, their wealth is in their labour and in the soil, and they have hitherto been handicapped by the very high rate of interest they have had to pay for the accomodation given them in the way of advances on their crops, etc.

It was but to be expected that the system would be spoken against by money lenders and others. Some too, even of those who have to depend on the people for their support, have said the system would never do in Jamaica because the people

cannot be trusted. A spirit such as this is not one calculated either to help the people, or to develop the industries of a country.

To the writer, it seems that a system such as this, to aid the people in their finances, is a necessary corollary to the efforts now being made by Agricultural Instructors and others, at no small cost of money, to teach improved methods of cultivation and to improve the character of the stock in the island.

While Mr. Palache must ever get the chief credit of introducing the system of Loan Banks in Jamaica, credit is also due to the Hon. W. Fawcett, Director of Public Gardens and Plantations, for the efforts he has made in different ways to recommend its adoption in the island.

As the result of Mr. Palache's efforts, several of the branches of the Agricultural Society in the parish of Manchester took the matter up and started banks, adopting the proposed scheme in its entirety. Mr. Palache prepared all the necessary books and forms, the system obtained the sanction of the Government and was registered under the Industrial and Provident Societies Law, 1902.

From some cause or another all but one of the various banks that were started have ceased to exist, and it is supposed that the Christiana People's Co-operative Bank, Limited, is the only one in operation in Jamaica at the present time. This bank was started on May 22, 1905. The system was very carefully explained before the bank was started, and since its commencement, meetings have been held in some of the surrounding districts and the benefits of the bank placed before the people. Although initiated in connexion with the Christiana Branch of the Agricultural Society, the loan bank was started as an independent concern, as some of the members of the branch did not approve of its policy. The number of members at its commencement was twenty, but three of these dropped out at an early period. In December 1906, the membership was twenty-six, and there were also three depositors. This is not a large number, but it is believed that it will be largely augmented in the near future when it is found that the bank is firmly established, and when its benefits in giving loans are realized by the people.

The share has been fixed at £5, and each member of the bank must be a holder of at least one share. The large size of the share, and the fact that it cannot be withdrawn, have prevented from joining many of those who would probably have done so had the share been fixed at £1, or if it had been possible for members to withdraw from the bank after joining. The fixing of the share at the higher amount, while lessening the number of those seeking to join, has had the effect of securing that only the most trustworthy and industrious men have become members. It is considered better to have a small number of substantial men than a large number, some of whom are unreliable.

While the shares cannot be withdrawn, they may be transferred from one to another, so that at death, or on

leaving the island, a member will not lose all he has paid. We believe the time will come when the shares will be sought after, and will realize when sold more than their par value.

The shares may be paid up at once, or by instalments. If the latter be adopted, the minimum rate of payment is 2*s.* per month. This gives four years to pay up the full amount of one share, and makes the payment of a share within the reach of every industrious man. At the present time, only two of the twenty-six shares are fully paid up. The monthly payments are being well kept up and there is not much over due to the bank. The entrance fee is 2*s.* 6*d.*, a book of rules costs 2*d.*, and a passbook 3*d.* This is all the outlay needed.

The bank is managed by a Committee of five, and has a President, Secretary, and Treasurer. All these officials are at present honorary. The members of the bank are men of high character and are among the most influential men in the districts in which they live. They are chiefly Day School teachers, who firmly believe in the bank and the benefits it is able to confer on the people.

The bank commenced to make loans in May 1906, and seven have been made up to the present for 'improving cultivation,' 'purchasing stock,' and 'purchasing land.' The value of these loans is £38. The first one has matured and has been repaid. The period for which loans are made is restricted to six months.

At present, the lending is confined to the shareholders, but as the bank grows, and more money than the shareholders are likely to require becomes available, the operations may be extended to outsiders. Already it has refused several applications for loans to outsiders.

The interest charged on loans is 10 per cent., or roughly speaking, ½*d.* per £ per week—a rate that is surprisingly low to people who have had to pay 6*d.* or even 1*s.* per £ per week interest.

After paying all the initial expenses, the reserve fund stands at £1 18*s.*, there are £20 in the Savings' Bank, and £32 out on loan. Of course these are small sums, but it is the beginning of a new and untried system among a not too confiding people.

The bank has existed since May 1905 and is steadily, though slowly, gaining ground. When the shares are fully paid up, at the present number of members only, £130 will be available for the accommodation of the best of the small settler class in the district the bank serves. Before the bank was started, this class of the community had no means of raising small loans to help them in their cultivation except from the usurer with his exorbitant interest, and it is felt that there are many men of the small-settler class who are honest and industrious and worthy of all the help that can be given them towards working their way up to a better financial position than they now occupy.

The bank is a deposit as well as a loan bank. A beginning has already been made in this direction, for there are three

depositors at present, and it is believed that it should be of great service to the community in this way, seeing that many of the people, especially of the labouring class, have no secure place for putting their money at deposit. It is hoped that people will soon realize this and will come forward in large numbers as depositors.

These are some of the chief features of the Christiana People's Co-operative Bank, Limited, and there would appear to be no reason why similar organizations should not be started in Jamaica and other parts of the Empire for the benefit of a deserving people.

MISCELLANEOUS SUBJECTS.

TEA IN JAMAICA.

BY THE HON. H. E. COX, Jamaica.

In bringing before you the subject of tea culture in this island, I will deal firstly with its history; secondly, the conditions under which it has taken place; thirdly, the mode of culture followed; and lastly, the preparation of the leaf for use. Tea is essentially a factory crop; by over production in the past the market prices have been forced down to such a low level that only by the use of the best machinery, and the utmost economy in management (for which a large area under cultivation is necessary), can the cost of production be recovered. But it is a safe crop for a settler who lives within range of an existing factory, for he can always have there a steady market for the leaf grown on his holding.

HISTORY OF TEA CULTURE AT JAMAICA.

The pedigree of the tea plant is a long one. The origin of its use as a beverage is lost in the mists of Chinese antiquity. Until the year 1833, it was not known to exist outside China, but in that year a variety, far more robust than the Chinese kind, was discovered in Assam, and became the parent of the Indian, and later of the Ceylon teas.

In Jamaica, the history of the tea plant dates only from 1868. Indian and Chinese varieties were then imported for the Government Gardens at Cinchona. In 1887, a cultivation of a few acres was made on the Blue Mountains, but was not continued, and no further attempt was made to grow it on a commercial scale until the cultivation was commenced at The Ramble in St. Ann. At first this experiment proceeded very slowly. The red soil of St. Ann is very different from the black soil of the Blue Mountains; the elevation of The Ramble above sea-level is only 1,600 feet, while that of the Gardens at Cinchona is 4,500 feet, and the rainfall in St. Ann is considerably less. It was therefore necessary to proceed cautiously.

The experiment was commenced with 250 plants and a packet of seed from Cinchona. After a year's trial, it was found that these grew freely; other plants and seed were then obtained from the same source to extend the cultivation, but the supply being necessarily limited, the increase of acreage was small. For some years no attempt was made to manufacture tea from the first few acres planted; the trees were left to grow on, to flower and bear seed for further planting. This reserved seed garden is now giving a steady supply, so that planting can go on more rapidly. It may be asked why seed was not imported. No seed could be had from Ceylon, as there is a prohibition in this colony against any

importation of seeds or plants from that island, so as to safeguard the country against any introduction of the coffee leaf disease.

From Assam, seed might have been obtained, but two reasons made it undesirable. Firstly, there was danger that some of the enemies of the tea plant which are found there might be introduced with the seed; and secondly, any change of soil and climate affects the character of the tea produced. The Cinchona strain was commenced with and it was thought better to keep to that alone.

The next step was to find out whether the leaf would make good tea. For this purpose a small quantity of the leaf was plucked, rolled by hand and dried in the sunshine. This proved to be of very good quality, and as all the initial difficulties were disposed of, the requisite machinery was imported, and the tea placed on the market in the latter part of 1903. The manufactured tea has a mild character similar to the old China teas, and the absence of astringency is a marked feature. At the beginning of 1906, about 100 acres were under cultivation (only a part being available for crop), and since then 50 acres more have been planted with seed.

CONDITIONS UNDER WHICH CULTURE HAS TAKEN PLACE.

The Ramble is on the north side of the island, 13 miles from St. Ann's Bay. It consists almost entirely of hills with a basis of white limestone, which provides complete natural drainage. The tops of the hill where the rock crops out are thickly covered with trees, while on the lower slopes lies a deep red soil. At the edge of the rocky parts the limestone is in many places decomposed into what is locally called gravel. It is only in the red soil that the tea plant looks healthy; seed planted on gravel will germinate, but the leaves are yellow and sickly, and the plant will die out.

There are no streams, and for practical purposes no springs, in the neighbourhood; the rainfall therefore is of primary importance. From Table I it will be seen that during the nine years, 1898 to 1906 the highest rainfall in the twelve months was 96·36 inches, the lowest 71·79 inches, and the average 82·80 inches. The greatest number of days in a year on which no rain fell was 194, the least number 145, and the average 163. The number of days with rainfall of ·01 to ·04 inches was, the greatest 70, the least 40, and the average 56. The number of days with a rainfall of ·05 to ·49 inches was, the greatest 111, the least 70, and the average 94. The number of days with rainfall of ·50 to less than 1 inch was, the greatest 33, the least 21, and the average 28. The number of days with rainfall 1 inch to under 2 inches was, the greatest 20, the least 13, and the average 17. The number of days with rainfall of 2 inches or over was, the greatest 10, the least 4, and the average 6⅔. It is therefore seen that, on the average, about 200 days in each year have some rain, and about 145 days have more than 5 points. The longest period in any year which had no rain of 5 points or over was 26 days, the shortest 9 days, and the average 16 days. The dry time occurs in March and April.

This even distribution of the rainfall is of the utmost importance, for the crop depends on a constant growth of young leaves (called flushes) being thrown out, and it is evident that frequent gentle rains, with intervals of bright sunshine, will produce the best results.

The average temperature of the year varies between 80·06° and 77·25° for the maximum, and 66·88° and 63·23° for the minimum. The day maximum has been above 90° only five times during the nine years (all these being in the years 1903 and 1904), and eight times below 65°. The night minimum has not gone above 73°, and once fell to 50°.

TABLE I.

SUMMARY OF RAINFALL FROM 1898 TO 1906.

Year.	Annual rainfall.	Number of days with:								Total.
		No rain.	Under ·05.	·05 to under ·50.	·50 to under 1 inch.	1 inch to under 2 inches.	2 inches to under 3 inches.	3 inches or over.	Not marked.	
1898	76·85	175	45	93	32	16	2	2	—	365
1899	90·56	194	44	70	28	20	5	4	—	365
1900	78·02	145	60	111	28	15	5	1	—	365
1901	86·99	150	70	85	33	19	6	2	—	365
1902	75·74	165	64	91	23	18	2	2	—	365
1903	71·79	157	69	90	29	13	2	3	2	365
1904	96·36	155	49	111	21	20	7	3	—	365
1905	77·35	176	40	98	29	13	4	3	2	365
1906	91·57	148	64	98	29	19	3	4	—	365
Average	82·80	163	56	94	28	17	6	$\frac{2}{3}$		

TABLE II.

AVERAGE TEMPERATURE FOR THE YEARS 1898 TO 1906.

	1898	1899	1900	1901	1902	1903	1904	1905	1906
Maximum	79 02	79·46	79·51	80·06	79·05	78·72	79·67	77·25	77·54
Minimum	66·55	66·74	66·88	62·25	64·29	63·23	64·59	64·48	64·07

THE MODE OF CULTURE.

The ground taken for planting has been common grass pastures. Three methods of preparing the ground for planting have been tried : (1) ploughing and cross ploughing, (2) forming trenches 1 foot wide and 18 inches deep, and (3) digging holes where the plants are to stand, about 15 inches cube.

It is not possible, at present, to express an opinion regarding the comparative merits of these methods ; in all the earlier cultivation the land was prepared by ploughing, and the last two methods have not been tried sufficiently long to judge results. The plants were, at first, put in 6 × 6 feet apart, but it was soon found that this gave too much room for weeds. A plant was then put in each interval in one direction, making the spaces 6 feet by 3 feet. In the later plantings, the distance has been still further reduced, the holes being placed 4 feet by 2 feet. It is I believe, in India, the custom to plant closely so as to cover the ground quickly, but I do not propose to reduce the interval between the rows below 4 feet, because that width is necessary to allow of cultivation and to let in light and air between the plants.

Propagation is by seed ; cuttings occasionally strike, but not sufficiently well to be useful. Planting the seed at stake appears to be preferable to forming seed-beds and transplanting. In the latter case a spell of dry weather and hot sunshine after transplanting may cause the loss of many plants. The seed may be germinated before being planted, but great care is then needed in planting it, as the young shoots are very fragile ; if not previously germinated, the plant should appear in from one or two months after sowing. When the plants have grown a few inches high, the ground is gone over and any gap supplied. In spite of this supplying, there appear gaps later on, which are filled with plants from seed-beds of about the same age as the rest of the field.

The cultivation for the next three or four years is simply to keep the ground between the plants as clean as possible. This entails a constant expenditure in destroying weeds one month to see them grown again in the next month. This long period of expenditure without income, combined with the con-considerable outlay for buildings and machinery, is the great drawback to the industry.

After about four years, when the plants may be about 4 feet high, they are cut down to a uniform height of about 9 inches. Of course all the leaves come off with the prunings, and the field becomes a scene of withered twigs and bare stumps. In six weeks these stumps will have thrown out a quantity of fresh young shoots, which are allowed to grow to a height of about 6 inches and are then tipped, i.e., the end is broken off. After a further wait of about a month, the fresh growth is plucked for crop. It is usually found that the first pluckings do not make such good tea as the later ones.

From this point the crop depends upon the weather. If there be mixed rain and warm sunshine, with moisture in the air, the trees should give a crop of leaves at about two weeks' interval for some months, gradually giving less as the time returns for pruning, which consists of cutting all the leaves down, and removing all knotty and badly grown wood. In the second cutting the plants are left 13 or 14 inches above ground, and in each succeeding year the height is increased about 2 inches. In India it is expected that each acre should give at least 1,000 lb. of green leaf in a season; but, as the yield must vary with the space allowed to each plant, the age of the plants, and to some extent also with the weather, it is impossible to make reallv reliable comparisons as to the yields per acre.

THE PREPARATION OF THE LEAF.

After plucking, there are four processes through which the leaf has to pass: first withering; second, rolling; third, fermenting; and fourth, drying.

In the old Chinese culture all was accomplished by hand labour, but in Jamaica it would be impossible to compete for commercial purposes without machinery.

The plucking of the leaves requires care; only the soft young growth at the end of the shoots must be taken, consisting of the bud with two, two and a half, or three leaves, according as whether the plucking is to be fine or coarse. The axils of the leaves below the part plucked must not be injured, and to break off the whole shoot at the joint (as is sometimes done) must be treated as a serious offence. The freshly plucked leaves have to be spread out as much as possible apart from each other to wither. For this purpose much space is required, as a single pound weight of leaf will need about a square yard. The best material on which to spread the leaf is wood. The time needed to wither the leaf is usually about fifteen to twenty hours, but the relative humidity of the atmosphere naturally affects it materially. When successfully withered the leaf should feel like thin, soft kid leather. The leaf is then put into the roller.

In hand making, a ball of leaves is taken in the two hands, and worked round and round on a table: the action of the machine is to imitate this movement. In some machines the box containing the leaf rotates on a fixed table, in others the leaf holder is fixed and the table rotates; in either case the leaf is kept in a constant twisting movement by raised ridges. This process gives the twisted look so familiar in dried tea, and

prepares the leaf for fermentation by partially crushing the cells, and making their contents accessible. The rolled leaf is passed through a rotating wire mesh cylinder to separate the large from the small leaves (as the large require more fermenting than the small), and each size is spread out thinly on cement-covered tables, and covered with a wet cloth. The leaf when put into the roller was bright green; on leaving the roller it has become yellowish.

As fermentation proceeds, the colour changes to bronze, and the scent of the leaf changes also. It is during this process that the substances which give flavour to the tea are formed, and good judgement is required by sight and smell to determine the time when the maximum of flavouring matter has been produced, for if left too long the substances giving the flavour are again decomposed, and the tea becomes flat and tasteless. When judged to be ready the leaf is carried to the drier, and subjected to strong heat (say, about 230° F.), which at once stops further fermentation and fixes the products.

The tea is spread on wire mesh trays in the drier, the action of which is to pass hot dry air through these trays, and thus carry off the moisture from the tea. The air is heated by passing through flues or tubes arranged in or around a furnace. There are several forms of drier. In some, the hot air passes upward from below; in others it is forced downward through the trays by a fan; and in others the leaf is carried through on moving trays. The leaf being wet when first put into the drier is not scorched by the high temperature, but after a short time it is advisable to move it into another drier at a lower temperature, say, 180° to 200° F.

When thoroughly dry, the tea is stored in large boxes until required for packing; a large quantity is then fed into a rotating cylinder with varying sizes of wire mesh, which sorts the dry leaf according to size, the smaller leaves being the finest. It has been the custom to call the various sizes by fancy Chinese names—Pekoe, Souchong, etc.—which are useless for purposes of classification, there being no standard by which to fix the terms. The tea is then packed, either in lead-lined chests, in tins, or in lead packets, and is ready for market.

THE INDUSTRIAL PROSPECTS OF CASSAVA STARCH.

BY THE HON. H. H. COUSINS, M.A., F.I.C., F.C.S.,

Government Analytical and Agricultural Chemist, Jamaica.

Although cassava has been grown in Jamaica from the earliest days of which any record is obtainable, it is only recently that its commanding merits as a source of high-class starch have attracted the attention of practical men.

It is now admitted that cassava starch has certain qualities that make it of exceptional utility in the dressing of cotton goods, and there is also reason to believe that the quality of the cassava starch producible in Jamaica is superior to that obtained from the same plant grown in the East Indies.

When this industry first attracted attention in 1908, principally through the efforts of Mr. J. W. Middleton, the greatest uncertainty existed as to the yields of tubers obtainable per acre and to the content of starch to be expected under the conditions obtaining in Jamaica.

The Chemical Department, therefore, undertook a study of this matter, and during the past three years a good deal of information has been obtained.

Starch manufacture has since been started at three centres in Clarendon, St. Ann, and St. Catherine, and we are already in sight of definite commercial results with the new industry.

The pioneers, as in all new undertakings, gain experience in a somewhat expensive school, and much work and ingenuity are still required before the industry can be placed on a sound and economical basis. The prospects are, however, most promising, and it is now quite possible to state that the cassava starch industry in Jamaica offers an attractive investment of capital.

YIELD OF TUBERS.

The results of the tests of twenty-one native varieties of cassava at Hope indicate that under the conditions of a moderate rainfall and a friable soil, very large yields of tubers are obtainable. At twelve months, a maximum yield of 10½ tons rising to 15½ tons at fifteen months and of nearly 22 tons of tubers per acre at twenty-one months has been recorded.

It is true that we could not expect to reap from 100 acres at the rate obtainable from a small plot of $\frac{1}{10}$ acre, and that on a large scale these enormous yields could hardly be expected as an average. At the same time, these results indicate that a return of 10 tons of tubers per acre should not be a difficult matter to realize under good cultivation. The indicated yield of starch per acre rose from 3½ tons at twelve months to 5½ tons at fifteen months, and over 7 tons of starch per acre at twenty-one months' growth in these trials.

As a starch producer, the cassava should therefore take the highest place among the economic plants of the world.

MATURATION AND VARIETIES.

Of the twenty-one local varieties of cassava tested in our experiments, two or three stood out as particularly prolific. Our experience of cassava varieties grown in Jamaica points very strongly to the necessity of planters testing all the best kinds themselves, as the greatest variations appear to exist in the behaviour of the same variety of cassava under different conditions of soil and climate.

As a rule, the variety grown by the local peasantry will be found to be one well suited to the district, and any planter commencing the cultivation of cassava on a large scale would do well to study very closely the practices of the small settlers in his district.

He would then learn that it was necessary to secure perfect drainage in the soil zone in which the tubers are produced, and would avoid the serious mistake of planting cassava on stiff soil on the flat, without any drainage at all. Serious losses of tubers have already occurred on some large cultivations through the neglect of this first principle of cassava cultivation. The resurrection of a Jamaica Carib of the pre-Columbian days would undoubtedly serve to give the cassava planter of to-day useful advice as to the successful cultivation of a crop that was formerly grown all over the island.

At Hope, the best variety for harvesting at twelve months' growth was found in the local cassava grown in the district, and known as 'white top.' This gave 10½ tons of tubers, containing nearly 4 tons of starch, per acre.

It would appear that in Jamaica a long period of growth is the most economical basis for cassava cultivation, and that quick returns and early maturing varieties do not afford such a prospect of profit as the larger yields of varieties of longer growth. The variety 'long leaf blue bud,' was found superior to the 'white top' when allowed to grow for fifteen months, yielding 15 tons of tubers, containing 5 tons of starch, per acre, while at twenty-one months' growth, the lead was taken by 'blue top' which gave the enormous return of 21·9 tons of tubers, containing over 7 tons of starch, per acre.

These results indicate that in the Liguanea Plain, it would be advisable for a starch factory to put in half its area in 'white top,' for quick returns, and the remainder in 'blue top' grown as a biennial.

It has still to be ascertained whether the practice in the East Indies of harvesting the mature tubers without destroying the plant, and leaving the small ones to grow on, is suitable for large-scale cultivation in Jamaica. In friable soil where the tubers are readily accessible, the treatment of the cassava plant as a perennial on this basis, might prove to be sound practice. The chief omen against the success of this method is that it would most certainly have established itself to be the custom of the country, had it been free from objection; since many generations of estate cultivators, inspired by the genius of the empty stomach, have been growing cassava in this

island, and it is certain that this must have been well tested in previous ages.

COST OF PRODUCTION OF TUBERS.

The cost of growing cassava on a large scale in Jamaica has been studied by Messrs. J. W. Middleton, Joseph Shore, the Hon. H. Cork, the Hon. J. V. Calder, and at the Hope Experiment Station. It has been deduced from the figures put forward, that cassava should cost, for cultivation only, from £3 13s. to £5 per acre, according to locality and circumstances.

The lower price represents the estimated cost under the most favourable conditions of broad-scale implemental culture on friable soils, while the higher price would be the cost of cassava farming on rocky land by hand labour.

An average cost of £4 per acre represents the estimated cost under favourable conditions of estate cultivation.

The Hon. Henry Cork has estimated that a capital of £1,000 to £2,000 would be required for starting a cultivation of 100 acres of cassava on new land. Allowing 10 per cent. on capital and 20 per cent. on live and dead stock account, Mr. Cork's estimate sets the actual cost of such a cultivation at £6 to £8 per acre. With regard to the yield of tubers to be expected, it would appear that an 8-ton crop should be a fair average, while good lands with efficient tillage should return 10 tons and more per acre. These figures indicate that cassava can be grown in Jamaica at less than £1 per ton.

Should cassava farming be started, it would be desirable for the purchasing factory to pay on the starch value of the tubers. We have found from experimental trials that the specific gravity of cassava tubers bears a definite relation to the percentage of starch they contain, and that it is possible approximately to ascertain the starch value of cassava tubers by means of the potato balance, used on the continent. A table is being prepared, giving the approximate starch content corresponding to the readings of the cassava balance, which should be useful to buyers of cassava in arriving at a fair price for the purchase of cassava tubers from contributary growers.

MANUFACTURE.

Much has still to be worked out as to the most efficient plan for dealing with the cassava grown in Jamaica, for the manufacture of starch, cassaripe, and cattle food. The first process is that of washing and decorticating the tubers. For this purpose the simple machine recently devised by the Hon. T. H. Sharp, which I have seen at work at Eltham Park, appears to be entirely satisfactory.

The great cost of peeling tubers by hand in the early experiments is thus entirely avoided, and the tubers are automatically washed and delivered free of the cortex by the operations of this machine. This invention has solved one of the outstanding difficulties that faced the starch producer in Jamaica.

To secure an efficient recovery of starch, the finest possible disintegration of the cut-tissues of the cassava is necessary. There are mills now obtainable that give excellent results and produce a very fine disintegration at a high rate of production.

A second grinding or disintegration should be carried out where starch is the main object of manufacture, but where a good market can be found for the dried residue as a cattle food, the second milling may probably be disregarded.

The sieving, purification, settling, refining, and drying of the starch seem all to be capable of easy accomplishment with suitable machinery, and there is now no doubt at all, that a starch factory to produce 1,000 tons of starch a year could be erected with every certainty of producing a high grade of cassava starch. Such a factory should not cost more than £6,000 or £7,000 to erect, and with intelligent management a satisfactory result should be assured.

COMMERCIAL VALUE OF CASSAVA STARCH.

It would appear that a well-made cassava starch is worth £14 to £16 per ton in the English market. A contract for a large quantity of cassava starch at the latter price has been secured by a planter in the West Indies, and sales of cassava starch from Jamaica have recently been made at £14 per ton, c.i.f. At such prices as these there is a liberal margin for meeting those contingencies of industrial operations in the West Indies for which it is impossible to make allowance, and on account of which many a project has proved a failure, when the apparent margin is too limited.

The 'bitty,' when dried, is a valuable cattle food. A sample from the Longville factory was found to contain 65·7 per cent. of carbohydrates on a basis of 15 per cent. of moisture, and should find a ready sale at 50*s*. to 60*s*. per ton. A planter from Dominica recently informed me that he had found a good market for cassaripe in England, and it is possible that this article may become a useful by-product in the manufacture of cassava starch. We in Jamaica have so far been unable to find a market for this product in the United Kingdom, and if a demand should arise it could be produced in large quantities here.

CONCLUSION.

Cassava is a plant that has survived from the earliest occupation of the island by mankind, and is capable of yielding returns of starch under suitable conditions. Those encouraging facts place it ahead of any other plant grown for purposes of starch production.

Further, the intrinsic qualities of cassava starches producible in Jamaica are of a high order, and a well-made article can command a high price.

It would appear that this industry offers a field for investment and development whereby large areas of land, at present of small productive power, could be made to yield a handsome profit.

CULTIVATION AND PREPARATION OF JAMAICA GINGER.

BY R. J. MILLER, Jamaica.

It is now between sixty and seventy years since ginger was introduced to Christiana in Jamaica. There are not many parts of the island where it can be grown, on account of its needs of a cool climate and suitable soil conditions.

The writer has ascertained by inquiries from some of the oldest inhabitants in the district that the root was first brought to Christiana during the time that Mr Richard Jackson was the attorney for Struan Castle estate, a property near Christiana, between the years 1835 and 1840.

The experiment of growing ginger on this property proved successful, and not long after, some white immigrants, chiefly from England and Ireland, settled in the district for the purpose of cultivating the article. By careful handling and attention, from the time of planting till the cured article was ready for export, they demonstrated the fact that this part of Jamaica was able to produce an excellent quality of ginger. The position thus easily attained in the market has been maintained by our ginger up to the present time, for it is now some of the best obtainable.

About 1840, the price of ginger from Jamaica gradually rose in the London market till it fetched as high as 180*s*. per cwt. This high price resulted in a great increase of the cultivation in and around the district. Many who had little or no experience in ginger cultivation planted it, prompted to do so by the high price, and a great deal of very inferior ginger found its way into the market. A fall of prices has been the result, but, even now, the finest product commands good prices.

It was the general opinion at first that ginger required fresh or virgin soil in order to produce the best results. The consequence was that year by year valuable timber plants were cut down, and large areas opened up for its cultivation. During the governorship of Sir Henry Blake, he visited this district and rode over the greater portion of the devastated country. He expressed the opinion that all this devastation was not necessary and that ginger could be successfully cultivated in properly tilled and manured lands.

Acting upon this suggestion, and through the advice of the Agricultural Society, experiments in growing ginger on manured land were commenced.

They were a decided success, and so proved the hitherto disbelieved fact that ginger could be cultivated around the houses of the peasantry.

An experiment was made a few years ago to grow ginger on a much larger scale than had hitherto been attempted, and to dry by artificial heat so as not to have to depend exclusively on the heat of the sun. The venture proved a success at first, but it would appear that just at that time the production exceeded the demand and the price fell.

The present outlook is not particularly hopeful, for unless the cultivation of the article will yield, at least, 40s. per 100 lb. to the grower for the best quality, the crop will become shorter year by year.

Another factor to be considered is that bananas grow freely on the ginger soil, and when it is considered how much less labour a crop of bananas takes than ginger, it will be seen at once that the one will be, in any case, preferred to the other. During the last two or three years the cultivation of bananas around Christiana has increased to a remarkable extent, and lands are becoming covered with the fruit which finds such a ready market in Great Britain and America. It is also understood that mountain-grown bananas compare favourably in flavour, etc, with those raised on the lowlands.

The small crop of 1905-6 seems to be a forecast of what is undoubtedly coming, for, as the cost of cultivating and curing ginger is great and laborious, many, finding that the prices obtained do not sufficiently warrant their continuing the cultivation, have turned their attention to other and more promising sources of income.

PREPARATION OF GINGER.

It may be interesting to some of the members of the Conference, who are not familiar with the preparation of ginger, to learn something of the method by which it is prepared for the market. It will be seen what a tedious process it is, one involving constant care for days, and dependent also on fine and bright sunshine all the time.

The plants, which are the small parts of the root not fit for peeling, are put in the ground from April to June of each year, and these are ready for harvesting from the following January to March. A second crop, called the ratoon crop, is reaped again in December without further planting.

Ratoon ginger is usually somewhat thinner than the first crop ginger, but for all practical purposes it is as good.

There are two kinds of ginger in this district, 'blue' and 'yellow.' The 'blue' was the first kind established, but gave way to the 'yellow,' which, however, does not seem to be preferred by merchants.

The root is dug up by the hoe, and then requires to be peeled—an operation which needs a skill only attained by considerable practice. The peeling consists in removing the outer skin with as little of the ginger as possible. The peeling of ginger is not easy, as will be seen by observing the root, and a particular narrow-bladed knife has to be used. To peel most effectively, the knife must be very sharp.

Ginger peeling is almost entirely done by women, many of whom employ their children to do the easier part of the work, that is, the sides of the roots. Thus from a very early age, the peeler is educated in the art, and during the ginger season many women, attracted by the work, flock into the district from all parts of the parish.

The peeling of ginger cannot be said to be hard labour, but it becomes sufficiently fatiguing for the hands if long continued. A good peeler should be able to peel 50 lb. of green ginger in a day, which when dried would weigh about 18 lb., and for this they are paid 1s.

After being peeled, the ginger is washed. It is then laid out to dry on small mats made from the mountain thatch, which has been found to be the best medium for drying ginger, for a certain amount of evaporation takes place on the under side as well as on the upper.

While being dried in this way, the ginger has to be turned over by hands piece by piece, at least once on the first day. This drying process occupies five to six days, according to the strength of the sun.

After being dried, it has to be bleeched by washing, in order to give it the white appearance. After this it receives two days' drying before being packed for export.

It was formally shipped in large casks, of a capacity of 4 to 5 barrels; but now it is shipped in barrels, and the common quality in bags.

THE SMALL-HOLDINGS COMPETITION IN JAMAICA.

BY W. CRADWICK,

Travelling Instructor in Agriculture, Jamaica.

After several years' work among the peasantry of Jamaica as an Agricultural Instructor, and connexion with many of the Agricultural Shows in the country, I arrived at the conclusion that something was required which would reach the peasant more directly and stir up in him a livelier interest in his everyday life.

To this end, a plan, based on a competition for cottage gardens, which I had seen carried out by the Hawkhurst Horticultural Society in England, was drawn up. This was called the Small-holdings Prize Scheme, and was placed before the Committee of the Experiment Station at Hope Gardens, with the suggestion that they might use their influence with the Jamaica Agricultural Society, in order to induce them to provide the money necessary to put it into operation.

Considerable delay occurred, but on his Grace the Archbishop taking up the scheme it was put into operation. On account of the preliminary delay, it had to be hurried in such a way as to make it fit into the financial year, and for want of proper personal advertising and explanation of its aims and objects, a good deal of suspicion was encountered. The entries for the first round of the competition were, therefore, very small.

The scheme as originally drawn up was published in the *Journal of the Jamaica Agricultural Society* (Vol. V, p. 14), and provided for prizes to be given for the cultivation of land and for the establishment of permanent or staple crops, to be competed for amongst small settlers and property headmen in different parishes of the island.

Some persons opposed to the scheme attempted to make a great deal of the apparent lack of interest on the part of the people whom it was intended to benefit, pointing to the small number of entries as evidence that it was unsuited to our peasantry and would never gain their confidence.

The lack of interest, however, was only apparent; the peasants' suspicion of the scheme was real, and who could have expected it to be otherwise. The scheme was put into operation and was intended to benefit a class whose chief acquaintance with the Government was through the Tax Collector; and any scheme in which the Government had even the smallest share was necessarily associated in their minds with a deep-laid plan to still further increase their taxes. That this suspicion was not unconquerable was the firm belief of the promoters of the scheme, for they were convinced that a scheme which so thoroughly entered into the details of the daily lives of the people in their own homes would in time become exceedingly popular.

The chief cause of the small number of entries during the first round of the competition was because the parishes were not sufficiently canvassed, and the scheme was not thoroughly explained to the people who were expected to compete. This was borne out by the fact that in Hanover, the first parish in which the scheme was properly explained, ninety people entered the competition.

The ministers and clergymen of all denominations took up the scheme heartily; the school teachers were perhaps even more enthusiastic, and on the latter becoming competitors, in many districts, the last breath of suspicion was blown away.

During the first round of the competition, the judges came to the conclusion that the money would be more profitably spent if divided into a larger number of prizes. The Rules were therefore amended to practically their present form, and are now as follows :—

'Prizes will be awarded for cultivation of land, and the establishment of permanent or staple crops.

'Only persons holding not more than 20 acres of land to be allowed to compete, and the land entered for competition must be one piece, not divided by other persons' property intervening; but a road, river, or gully may run through it.

'The residence of the competitor to be on the ground entered for competition; and such residences and grounds to be situated near (within a stated distance of) a Main or Parochial road.

'The prizes to be allotted in three classes :

First Class Holdings not over 20 acres.

Second Class Holdings not over 10 acres.

Third Class Holdings not over 5 acres.

'No person to compete in more than one class, but competitors may select any class for which he or she can qualify, and no prizes will be awarded unless there are at least twice as many competitors as there are prizes offered.

'Prizes to be given in each parish as follows :—

	1st Prize.			2nd Prize.			3rd Prize.			4th Prize.			5th Prize.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
1st Class Holdings not over 20 acres ...	4	0	0	3	0	0	2	0	0	1	5	0	0	15	0
2nd Class Holdings not over 10 acres...	3	0	0	2	0	0	1	10	0	1	0	0	0	10	0
3rd Class Holdings not over 5 acres ...	2	0	0	1	11	0	1	4	0	0	16	9	0	9	0

'No person to be allowed to compete in Class I unless he or she has 5 acres in permanent crops such as coffee, cacao, oranges, grape fruits, limes, cocoa-nuts; no one to be allowed to compete in Class II unless he or she has 3 acres in such permanent crops; and no one shall be allowed to compete in Class III unless he or she has 1 acre in such permanent crops.

'The judging will be conducted on a system of points as follows:—

Permanent crops	Points	30
Catch crops	„	15
Fences, gates, and general condition of holding ...		15
Live stock		20
House		10
Sanitary conditions, etc.		10

'The method of cultivation and condition of the crops grown, rather than the kinds of crops grown, to be considered by the Judges. Crops for which premiums are awarded need not necessarily have reached maturity, and points may be given for cultivation in progress, provided it is, in the opinion of the Judges, sufficiently advanced to admit of its being judged. The Judges to consider the circumstances of each cultivation as well as the cultivation itself, including the implements used.

'It should be competent for the Judges to withhold any or all of the Prizes if the Holdings entered for competition are not considered of sufficient merit.

'Three months' notice, at least, to be given before judging commences, and the decision of the Judges in all cases to be final.'

It is now four years since the competition was put into operation, and the largely increasing number of entries is sufficient guarantee of the popularity of the scheme among the small settlers.

With regard to the benefits of the scheme, I think these are so far in excess of the money required to carry out the competition, that it is hoped that the Agricultural Society will see its way to keep to that part of the original plan, which provided for the competition being held in every parish every third year, necessitating judging four parishes during two consecutive years, and five parishes in the third year, so as to embrace the thirteen agricultural parishes during the cycle of three years.

There is of course a great deal of very hard and laborious work to carry out the scheme properly; nearly all the holdings are situated in the mountains; many of them in parishes such as Portland, St. Thomas, St. Andrew, St. Ann, and St. Elizabeth, where they are situated on the tops of high hills and are such that very few of them can be ridden to. After a month or five weeks of such work, there is little energy left in the Judges for some time afterwards.

If the competition can be so arranged that the people can rely on its taking place every third year, and the Instructors are able to hold up this as an inducement before them, I am

quite convinced that the present benefit of the competition would be more than double with the same expenditure of money. Continuity, which seems so hard to obtain, is the key-stone of success in matters such as this.

The great thing needed among our peasantry is stimulus to exertion. The Small-holdings Competition has supplied this in a manner which far exceeds even the most sanguine hopes. The amount of work which is put into a holding in the hopes of winning what after all can only be a very small prize, would astonish any one in this audience who has not actually seen it. Pruning and cleaning up of cultivations, grooming of stock, repairing of roads, walls and fences, tanks, and houses, white washing, and painting are what were expected; but when it is observed that new cultivations established from the time of the first competition, men buying and keeping cows, new tanks, new walls, new gates, sanitary systems established where none were before, stables erected, and even new houses built in order to try and win these prizes, it must be acknowledged that this scheme has taken a hold upon the peasantry and acted as a stimulant to them, the value of which can never be over estimated.

For the recent competition in St. Ann, Mr. Arnett and myself calculated that there could not have been less than £1,000 worth of labour put into the different holdings competing.

It is interesting to hear the views of the competitors themselves. In the beginning, the competitor was often met with who timidly asked for personal assurance that the Government did not intend to take away their places; others were afraid taxes would be raised; some thought that the shilling would have to be paid every year as long as they live. But now it is found that although the suspicions are not entirely killed, they become less and less each year, and the comments are assuming an entirely different tone.

I have perhaps left the most beneficial aspect of the scheme to the last, and that is the unrivalled facilities it affords for practical instruction. It gives an Instructor an excuse for going into places, and insures him a welcome, which I think he would have looked for in vain for many long years, had it not been for the institution of this competition. The mere judging of the holding and awarding of the prizes are as nothing compared with the patient inspection and pointing out in a friendly spirit the possibilities for improving almost every department of that which constitutes their home and home life. From this aspect alone, it is obvious that the scheme is worth far more than the expenditure involved.

In conclusion, it should be mentioned that this scheme breaks down the barrier of suspicion existing between the Government and the peasantry, and that the stimulus supplied by it is not by any means confined to the competitors, for the effects are often seen over whole districts.

THE TIMBERS OF JAMAICA.

In view of the increase in the prices of imported lumber during the past few years, and, according to the general opinion, the deterioration of its quality, the question as to the suitability of the woods obtainable from the forests of British Guiana and many of the West India Islands for general, as well as for fancy purposes, has recently been brought forward. The islands of Dominica, Jamaica, and Trinidad, and the colony of British Guiana have had under consideration the possibility of obtaining a good supply of timber of a reliable character from their forests for local and for export purposes.

Certain classes of timber are exported from British Guiana and from Trinidad, but one of the difficulties has been the lack of information as to the use to which their woods are the best suited. A paper on the timbers of Jamaica, prepared by Mr. W. Harris, F.L.S., Superintendent of Hope Gardens, for the West Indian Agricultural Conference gives a short description of each of the principal timber trees of that island about which he was able to obtain reliable information. As many of these are distributed throughout the West India Islands, this paper contains much of the information in respect to the value of their different woods that has continually been required. An article of this nature embodies a large amount of work and contains much information of a useful character, and, therefore, the following abstract,* together with the lists of the chief woods under their respective uses should prove of immediate interest:—

The woodlands of Jamaica are not confined to any particular parts of the island, for in every parish forests occupy extensive areas. The estimated total of woodlands, by the Surveyor General, is 400,000 to 500,000 acres, exclusive of scrublands—about one-sixth of the island.

In cleared districts the trees that usually meet the eye are grown, or allowed to grow, for the fruit they produce, for the shade they give, or for ornament. Whilst many of the trees found in the forests of the island, requiring certain climatic conditions for their successful growth, are confined to comparatively limited areas in a few special districts, others appear to be able to adapt themselves equally well in the various districts. There are, nevertheless, three fairly well-defined types of woodland, namely, the savannahs and hills near the coast with a rainfall of about 30 to 50 inches per annum, the middle region and interior hills up to 3,500 feet altitude with a rainfall of from 70 to 90 inches per annum, and the highland region above 3,500 feet altitude with a rainfall of from 90 to 150 inches or more.

The value of native lumber, such as mahogany, cedar, mahoe, bully tree, etc., in the interior of the island is about

* Owing to pressure for space in this number of the *West Indian Bulletin*, the publication of the complete article has been found to be impossible, and, therefore, it has been held over for a subsequent issue. [Ed. *W. I. B.*]

14*s.* per 100 superficial feet for boards, and trees are valued at the rate of 1*s.* per 100 feet of the boards they are estimated to yield. To a wholesale buyer the prices would be somewhat lower. The cost of felling timber and hand-sawing lumber is generally as follows : –

Boards	...	£4 5*s.* per 1,000 superficial feet.
Scantlings	...	£3 „ „ „ „

and that of splitting shingles, from 18*s.* to 20*s.* per 1,000.

To the above prices must be added the cost of removing the lumber from the saw-pit to the nearest cart road, and of cartage to the nearest railway station or port.

The value of such lumber delivered at Kingston is now about £10 per 1,000 superficial feet, and of shingles, such as cedar or mahoe, about 62*s.* per 1,000; while the prices of imported lumber may be taken as follows :—

White pine,	rough,	£9	per 1,000 superficial feet.
„ „,	dressed,	£9 10*s.*	„ „ „ „
Pitch pine,	rough,	£9 10*s.*	„ „ „ „
„ „,	dressed,	£10	„ „ „ „
Shingles, dressed Cypress, 72*s.* 6*d.* per 1,000.			

It was estimated by Mr. E. D. M. Hooper, an officer of the Indian Forest Department who visited Jamaica in 1885-6 for the purpose of investigating the question of forest conservation, and by the Crown Surveyor, that the total area of forests in Jamaica was 800,000 acres, but that this was being cleared at the rate of of 30,000 acres annually, principally by the cultivators of ground provisions and, in a small way, by the ginger growers. Much of this cleared land has been allowed to grow up into bush and a few soft-wooded and worthless trees have made their appearance; but it is estimated that such lands, if left undisturbed, would probably take 200 years before they could assume any semblance in their growth to the adjoining virgin woodlands of which they are parts, and it may take twice that length of time before they are completely re-afforested by trees of the original species, for the growth of trees of hardwood is extremely slow.

This clearing of the land naturally suggests the need of planting up areas of good timber trees for the supply of the future, and in this connexion it might be mentioned that good timber such as West Indian cedar, might be grown to a useful size in thirty to thirty-five years.

For many years past, large numbers of seedling timber trees have been distributed free from the Public Gardens, but owing to the difficulty experienced in securing regular and reliable supplies of seeds it has been found necessary to request that at least one year's notice be given, if a large supply of young timber trees of any particular variety is required. It also occasionally happens that certain kinds of trees cannot be supplied for several years on account of failure to procure good seeds. Notable in this direction is the Juniper cedar, which only produces crops of good seeds at intervals of several years.

LIST OF WOODS SUITABLE FOR CABINET WORK.

Local Name.	*Botanical Name.*
Braziletto	*Peltophorum Linnaei*, Benth.
Breadfruit	*Artocarpus incisa*, Linn.
Breadnut	*Brosimum Alicastrum*, Sw.
Cashew	*Anacardium occidentale*, Linn.
Cedar, Juniper	*Juniperus bermudiana*, Linn.
Cedar, West Indian ..	*Cedrela odorata*, Linn.
Cocoa-nut	*Cocos nucifera*, Linn.
Dog-wood	*Piscidia Erythrina*, Linn.
Ebony, or Coccus Wood ...	*Brya Ebenus*, DC.
Fiddle-wood	*Petitia domingensis*, Jacq.
Fustic	*Chlorophora tinctoria*, Gaudich.
Greenheart, or Break-axe...	*Sloanea jamaicensis*, Hook.
Gru-gru Palm	*Acrocomia lasiospatha*, Mart.
Horse-wood	*Pithecolobium latifolium*, Benth.
Indian Tulip Tree	*Thespesia populnea*, Soland.
Jack Fruit	*Artocarpus integrifolia*, Linn.
Ligum-vitae	*Guaiacum officinale*, Linn.
Locust Tree	*Hymenaea Courbaril*, Linn.
Logwood	*Haematoxylon campechianum*, Linn.
Mahoe, Blue or Mountain ...	*Hibiscus elatus*, Sw.
Mahogany	*Swietenia Mahagoni*, Jacq.
Mangrove, Black	*Avicennia nitida*, Jacq.
Mosquito-wood	*Mosquitoxylum jamaicense*, Kr. et Urb.
Naseberry	*Achras Sapota*, Linn.
Naseberry Bullet, or Bully Tree... ...	*Mimusops Sideroxylon*, Pierre.
Pigeon-wood	*Diospyros tetrasperma*, Sw.
Prickly Yellow	*Zanthoxylum martinicenise*, DC.
Red-bead Tree	*Adenanthera pavonina*, Linn.
Rosewood, or Torch-wood...	*Amyris balsamifera*, Linn.
Sapodilla	*Mimusops excisa*. Urb.
Satin-wood	*Zanthoxylum flavum*, Vahl.
Sea-side Grape	*Coccoloba uvifera*, Linn.
Soap-berry	*Sapindus Saponaria*, Linn.
Spanish Elm	*Cordia gerascanthoides*, H.B. & K.
Star Apple	*Chrysophyllum Cainito*, Linn.
Sumach, Hog Doctor, etc. ...	*Rhus Metopium*, Linn.
Tamarind	*Tamarindus indica*, Linn.
Wild Orange	*Esenbeckia pentaphylla*, Griseb.
Wild Tamarind	*Pithecolobium filicifolium*, Benth.
Woman's Tongue	*Albizzia Lebbek*, Benth.
Yacca, Blue Mountain ...	*Podocarpus Urbani*, Pilger.
Yacca, St. Ann's	*Podocarpus Purdieana*, Hook
Yellow Candle-wood ...	*Cassia emarginata*, Linn.
Yellow Sanders, etc. ...	*Terminalia capitata*, B. & H.
Yoke-wood, Mast-wood, etc.	*Catalpa longissima*, Sims.
Zebra Wood, Satin-wood ...	*Zanthoxylum caribaeum*, Lam.
Zebra Wood, Mountain ...	*Eugenia fragrans*, Willd.

LIST OF WOODS SUITABLE FOR CARRIAGE AND CART WORK.

Local Name.	*Botanical Name.*	*Remarks.*
Bastard Cabbage Bark, or Angelin	*Andira inermis*, H.B. & K.	
Braziletto	*Peltophorum Linnaei*, Benth.	Spokes.
Calabash	*Crescentia Cujete*, Linn.	
Cashaw	*Prosopis juliflora*, DC.	
Cedar, West Indian	*Cedrela odorata*, Linn.	
Dogwood	*Piscidia Erythrina*, Linn.	For naves and felloes.
Fiddle-wood ...	*Petitia domingensis*, Jacq.	For felloes
Fustic	*Chlorophora tinctoria*, Gaudich.	Naves and wheels.
Indian Tulip Tree	*Thespesia populnea*, Soland.	
Lancewood, Black	*Bocagea virgata*, B. & H.	For shafts and poles.
Lancewood, White	*Bocagea laurifolia*, B. & H.	For shafts and poles.
Mahoe	*Hibiscus elatus*, Sw.	For felloes.
Naseberry Bully, or Bullet Tree	*Mimusops Sideroxylon*, Pierre.	For spokes.
Pimento	*Pimenta officinalis*, Lindl.	For tongues and shafts.
Santa Maria ...	*Calophyllum Calaba*, Jacq.	For felloes.
Sapodilla	*Mimusops excisa*, Urb.	For spokes.
Spanish Elm ...	*Cordia gerascanthoides*, H.B. & K.	For tongues and shafts.

LIST OF WOODS SUITABLE FOR COOPERING WORK.

Broad-leaf	*Terminalia latifolia*, Sw.
Clammy Cherry	*Cordia Collococca*, Linn.
Hog Plum	*Spondias lutea*, Linn.
Mango	*Mangifera indica*, Linn.
Sweet-wood, Loblolly ...	*Nectandra Leucoxylon*, B. & H.
Sweet-wood, Yellow ...	*Nectandra antillana*, Meissn.
West Indian Birch, or Mastic	*Bursera gummifera*, Linn.
Wild Cassada	*Turpinia occidentalis*, G. Don.

LIST OF WOODS SUITABLE FOR FUEL.

———	*Acacia tortuosa*, Willd.
Cashaw	*Prosopis juliflora*, DC.
Mango	*Mangifera indica*, Linn.
Park-nut	*Acacia macracantha*, Humb. & Bonpl.
West Indian Birch, or Mastic	*Bursera gummifera*, Linn.
Yellow Candle-wood ...	*Cassia emarginata*, Linn.

LIST OF WOODS SUITABLE FOR GENERAL PURPOSES.

(Inside work.)

Local Name.	*Botanical Name.*
Akee	*Blighia sapida*, Kon.
Bastard Cedar	*Guazuma tomentosa*, H.B. & K.
Bitter Dan, Bitter Damson, Stavewood	*Simaruba glauca*, DC.
Bread-nut	*Brosimum Alicastrum*, Sw.
Broad-leaf	*Terminalia latifolia*, Sw.
Cedar, West Indian ...	*Cedrela odorata*, Linn.
Clammy Cherry	*Cordia Collococca*, Linn.
Ginep	*Melicocca bijuga*, Linn.
Guango	*Pithecolobium Saman*, Benth.
Lignum Dorum	*Ocotea staminea*, Mez.
Locust-berry, or Hog-berry	*Byrsonima crassifolia*, H.B. & K., var. *jamaicensis*, Urb. & Neid.
Mahoe, Sea-side	*Hibiscus tiliaceus*, Linn.
Mahogany	*Swietenia Mahagoni*, Jacq.
Mammee Sapota	*Calocarpum mammosum*, Pierre.
Mango	*Mangifera indica*, Linn.
Prune	*Prunus occidentalis*, Sw.
Ramoon	*Trophis americana*, Linn.
Red, or Cherry Bull Tree, or Galimenta	*Dipholis nigra*, Griseb.
Santa Maria	*Calophyllum Calaba*, Jacq.
Shad-bark	*Pithecolobium Alexandri*, Urb., and varieties.
Silk-cotton, or Ceiba .	*Eriodendron anfractuosum*, DC.
Soap-wood	*Clethra tinifolia*, Sw.
Spanish Elm	*Cordia gerascanthoides*, H.B. & K.
Sumach, Hog Doctor, etc. .	*Rhus Metopium*, Linn.
Sweet-wood, Loblolly ...	*Nectandra Leucoxylon*, B. & H.
Sweet-wood, Yellow ...	*Nectandra antillana*, Meissn.
Wild Cassada	*Turpinia occidentalis*, G. Don.
Wild Tamarind	*Pithecolobium filicifolium*, Benth.
Yacca, Blue Mountain ...	*Podocarpus Urbanii*, Pilger
Yacca, St. Ann's	*Podocarpus Purdieana*, Hook.
Yoke-wood, Mast-wood ...	*Catalpa longissima*, Sims.

LIST OF WOODS SUITABLE FOR GENERAL PURPOSES.

(Exposed situations.)

Bastard Cabbage Bark, or Angelin	*Andira inermis*, H.B. & K.
Blind-eye, or Yucco ...	*Sapium cuneatum*, Griseb.
Blood-wood, or Iron-wood	*Laplacea Haematoxylon*, G. Don.
Boxwood, or Fiddle-wood	*Vitex umbrosa*, Sw.
Braziletto	*Peltophorum Linnaei*, Benth.
Bullet, or Bully Tree, Mountain	*Dipholis montana*, Griseb.
Cashaw	*Prosopis juliflora*, DC.
Cashew	*Anacardium occidentale*, Linn.

LIST OF WOODS SUITABLE FOR GENERAL PURPOSES.—(*Concluded.*)

(Exposed situations.)

Local Name.	*Botanical Name.*
Cedar, Juniper	*Juniperus bermudiana*, Linn.
Cedar, West Indian ...	*Cedrela odorata*, Linn.
Cro-cro	*Tecoma Brittonii*, Urb.
Cromanty	*Ratonia apetala*, Griseb.
Fiddle-wood	*Petitia domingensis*, Jacq.
Greenheart, or Break-axe...	*Sloanea jamaicensis*, Hook.
Gutter-wood	*Strempeliopsis arborea*, Urb.
Horse-wood	*Pithecolobium latifolium*, Benth.
———	*Ilex obcordata*, Sw.
Mammee Apple	*Mammea americana*, Linn.
Mammee Sapota	*Calocarpum mammosum*, Pierre.
Mangrove, Red	*Rhizophora Mangle*, Linn.
Mosquito Wood	*Mosquitoxylum jamaicense*, Kr. et Urb.
Naseberry Bullet, or Bully Tree	*Mimusops Sideroxylon*, Pierre.
Nickel, or Bead Tree ...	*Ormosia monosperma*, Urb.
Pimento	*Pimenta officinalis*, Lindl.
Prune	*Prunus occidentalis*, Sw.
Red-bead Tree	*Adenanthera pavonina*, Linn.
Red, or Cherry Bully Tree, or Galimenta	*Dipholis nigra*, Griseb.
Rose-wood	*Drypetes ilicifolia*, Kr. et Urb.
Rose-wood, or Torch-wood	*Amyris balsamifera*, Linn.
Santa Maria	*Calophyllum Calaba*, Jacq.
Sapodilla	*Mimusops excisa*, Urb.
Shad-bark	*Pithecolobium Alexandri*, Urb. and varieties.
Slug-wood	*Beilschmiedia pendula*, Hemsl.
Star Apple	*Chrysophyllum Cainito*, Linn.
———	*Tetrochidium rubrivenium*, Poepp. & Endl. var. *integrifolium*, Muell. Arg.
Wild Juniper	*Lyonia jamaicensis*, D. Don. and *L. octandra*, Griseb.
Yacca, St. Ann's	*Podocarpus Purdieana*, Hook.
Yellow Sanders, etc. ...	*Terminalia capitata*, B. & H.
Yoke-wood, Mast-wood, etc.	*Catalpa longissima*, Sims.
Zebra Wood, Mountain ...	*Eugenia fragrans*, Willd.

LIST OF WOODS SUITABLE FOR HOUSEWORK AND FURNITURE.

Almond, Tropical	*Terminalia Catappa*, Linn.
Breadfruit	*Artocarpus incisa*, Linn.
Bread nut	*Brosimum Alicastrum*, Sw.
Cedar, Juniper	*Juniperus bermudiana*, Linn.
Cedar, West Indian ...	*Cedrela odorata*, Linn.
Cocoa-nut	*Cocos nucifera*, Linn.
Fiddle-wood	*Petitia domingensis*, Jacq.
Fustic	*Chlorophora tinctoria*, Gaudich.
Hog Gum	*Symphonia globulifera*, Linn.
Indian Tulip Tree	*Thespesia populnea*, Soland.

LIST OF WOODS SUITABLE FOR HOUSEWORK AND FURNITURE. (*Concluded.*)

Local Name.	*Botanical Name.*
Jack Fruit	*Artocarpus integrifolia*, Linn.
Locust Tree	*Hymenaea Courbaril*, Linn.
Mahoe, Blue or Mountain	*Hibiscus elatus*, Sw.
Mahogany	*Swietenia Mahagoni*, Jacq.
Mammee Sapota	*Calocarpum mammosum*, Pierre.
Mangrove, White	*Laguncularia racemosa*, Gaertn.
Mosquito-wood	*Mosquitoxylum jamaicense*, Kr. et Urb.
Naseberry	*Achras Sapota*, Linn.
Naseberry Bullet, or Bully Tree	*Mimusops Sideroxylon*, Pierre.
Nickel, or Bead Tree ...	*Ormosia monosperma*, Urb.
Prickly Yellow	*Zanthoxylum martinicense*, DC.
Red-bead Tree	*Adenanthera pavonina*, Linn.
Red, or Cherry Bully Tree, or Galimenta	*Dipholis nigra*, Griseb.
Santa Maria	*Calophyllum Calaba*, Jacq.
Satin-wood	*Zanthoxylum flavum*, Vahl.
Sumach, Hog Doctor, etc....	*Rhus Metopium*, Linn.
Sweet-wood, Timber ...	*Nectandra exaltata*, Griseb.
Tamarind	*Tamarindus indica*, Linn.
Wild Orange	*Esenbeckia pentaphylla*, Griseb.
Wild Tamarind	*Pithecolobium filicifolium*, Benth.
Woman's Tongue	*Albizzia Lebbek*, Benth.
Yacca, Blue Mountain ...	*Podocarpus Urbanii*, Pilger.
Yacca, St. Ann's	*Podocarpus Purdieana*, Hook.
Yoke-wood, Mast-wood, etc.	*Catalpa longissima*, Sims.
Zebra-wood, Satin-wood ...	*Zanthoxylum caribaeum*, Lam.

LIST OF WOODS SUITABLE FOR MILL WORK.

Blood-wood	*Laplacea Haematoxylon*, G. Don.
Cogwood, or Greenheart ..	*Zizyphus chloroxylon*, Oliv.
Dogwood	*Piscidia Erythrina*, Linn.
Greenheart, or Break-axe..	*Sloanea jamaicensis*, Hook.
Lignum-vitae	*Guaiacum officinale*, Linn.
Locust Tree	*Hymenaea Courbaril*, Linn.
Santa Maria	*Calophyllum Calaba*, Jacq.
Woman's Tongue	*Albizzia Lebbek*, Benth.

LIST OF WOODS SUITABLE FOR PILES.

Bastard Cabbage Bark, or Angelin	*Andira inermis*, H. B. & K.
Blind-eye or Yucco... ..	*Sapium cuneatum*, Griseb.
Button-wood	*Conocarpus erecta*, Linn.
Cocoa-nut	*Cocos nucifera*, Linn.
Dogwood	*Piscidia Erythrina*, Linn.
Fiddle-wood	*Petitia domingensis*, Jacq.

LIST OF WOODS SUITABLE FOR PILES.—(*Concluded.*)

Local Name.	*Botanical Name.*
Mammee Apple	*Mammea americana*, Linn.
Mangrove, Black	*Avicennia nitida*, Jacq.
Mangrove, Red	*Rhizophora Mangle*, Linn.
Nickel, or Bead Tree ...	*Ormosia monosperma*, Urb.
Prune	*Prunus occidentalis*, Sw.
White-wood	*Tecoma leucoxylon*, Mart.

LIST OF WOODS SUITABLE FOR POSTS.

Blood-wood, or Iron-wood	*Laplacea Haematoxylon*, G. Don.
Button-wood	*Conocarpus erectus*, Linn.
Cashaw	*Prosopis juliflora*, DC.
Cedar, Juniper	*Juniperus bermudiana*, Linn.
Horse-wood	*Pithecolobium latifolium*, Benth.
Logwood	*Haematoxylon campechianum*, Linn.
Maiden Plum	*Comocladia integrifolio*, Jacq.
Maiden Plum	*Comocladia velutina*, Britton.
Mammee Apple	*Mammea americana*, Linn.
Mangrove, Black	*Avicennia nitida*, Jacq.
Mangrove, Red	*Rhizophora Mangle*, Linn.
Pigeon-wood	*Diospyros tetrasperma*, Sw.
Spanish Elm	*Cordia gerascanthoides*, H. B. & K.
Torch-wood or Flambeau	*Tecoma stans*, Juss.
White-wood	*Tecoma leucoxylon*, Mart.
Wild Juniper	*Lyonia jamaicensis*, D. Don. and *L. octandra*, Griseb.
Yellow Candle-wood ...	*Cassia emarginata*, Linn.

LIST OF WOODS SUITABLE FOR RAILWAY SLEEPERS.

Blind-eye, or Yucco ...	*Sapium cuneatum*, Griseb.
Braziletto	*Peltophorum Linnaei*, Benth.
Cashaw	*Prosopis juliflora*, DC.
Dogwood	*Piscidia Erythrina*, Linn.
Fiddle-wood	*Petitia domingensis*, Jacq.
Mahoe, Blue or Mountain	*Hibiscus elatus*, Sw.
Sapodilla	*Mimusops excisa*, Urb.
Shad Bark	*Pithecolobium Alexandri*, var. *Troyanum*, Urb.

LIST OF WOODS SUITABLE FOR SHINGLES.

Alligator-wood	*Guarea trichilioides*, Linn.
Broad-leaf	*Terminalia latifolia*, Sw.
Bullet, or Bully Tree, Mountain	*Dipholis montana*, Griseb.
Cedar, West Indian ..	*Cedrela odorata*, Linn.
Hog Gum	*Symphonia globulifera*, Linn.

LIST OF WOODS SUITABLE FOR SHINGLES.—(*Concluded.*)

Local Name.	*Botanical Name.*
Lignum Dorum	*Ocotea staminea*, Mez.
Mahoe, Blue or Mountain...	*Hibiscus elatus*, Sw.
Red, or Cherry Bully Tree, or Galimenta	*Dipholis nigra*, Griseb.
Santa Maria	*Calophyllum Calaba*, Jacq.
Silk-cotton, or Ceiba ...	*Eriodendron anfractuosum*, DC.
Soap-wood	*Clethra tinifolia*, Sw.
Sweet-wood, Yellow ..	*Nectandra antillana*, Meissn.
Sweet-wood, Timber ...	*Nectandra exaltata*, Griseb.
Yellow Sanders, etc. .	*Terminalia capitata*, B. & H.

LIST OF WOODS SUITABLE FOR TURNERY.

Blood-wood, or Iron-wood	*Laplacea Haematoxylon*, G. Don.
Calabash	*Crescentia Cujete*, Linn.
Cocoa-nut Palm	*Cocos nucifera*, Linn.
Dog-wood	*Piscidia Erythrina*, Linn.
Ebony or Coccus-wood ...	*Byra Ebenus*, DC.
Greenheart or Break-axe ...	*Sloanea jamaicensis*, Hook.
Gru-gru Palm	*Acrocomia lasiospatha*, Mart.
Indian Tulip Tree	*Thespesia populnea*, Soland.
Jack Fruit	*Artocarpus integrifolia*, Linn.
Lancewood, Black	*Bocagea virgata*, B. & H.
Lancewood, White... ...	*Bocagea laurifolia*, B. & H.
Lignum-vitae	*Guaiacum officinale*, Linn.
Locust Tree	*Hymenaea Courbaril*, Linn.
Maiden Plum	*Comocladia integrifolia*, Jacq.
Maiden Plum	*Comocladia velutina*, Britton.
Mountain Guava	*Psidium montanum*, Sw.
Nasberry Bullet, or Bully Tree	*Mimusops Sideroxylum*, Pierre.
Sapodilla	*Mimusops excisa*, Urb.
Star Apple	*Chrysophyllum Cainito*, Linn.
Tamarind	*Tamarindus indica*, Linn.

AGRICULTURAL EDUCATION.

AGRICULTURAL AND SCIENTIFIC TEACHING IN THE SECONDARY SCHOOLS OF JAMAICA.

BY THE REV. CANON SIMMS, M.A.,

Principal of the Jamaica College.

By agreement with the other members of the Educational Section of the Jamaica members of the Conference, my task has been reduced to communicating what there is to be said upon the agricultural and scientific teaching in the secondary schools of Jamaica. I think the Conference has reached the stage at which it is not necessary to lay down and argue out general principles: it has been done by many of us, and at some length and with some reiteration by myself, at previous Conferences. The question now is,--what we are actually doing?

A plan for agricultural teaching in all its branches, including that in secondary schools, had been drawn up, and the University of Cambridge had been induced, mainly by the Education Board of Barbados, to introduce an agricultural section into its local examinations. These examinations hold a very important place in our Jamaica system of secondary education; and, in taking some share in persuading the University to adopt the section, I hoped to introduce agriculture into our secondary schools as a subject for the boys it concerned, side by side with the other subjects for boys who were not taking agriculture.

With the departure of Dr. Watts from Jamaica and the formation of the Board of Agriculture, a considerable change came over our plans. The secondary school work of the Lecturer in Agricultural Science was stopped; the Cambridge syllabus was disapproved of, so that the schools could get no help from the Agricultural Department in preparing boys for it; and my own share in directing the matter as a member of the Experiment Station Committee ceased with the abolition of that committee. The plan of higher agricultural instruction at the laboratory, as originally arranged and worked, eliminated all the parts of the previous scheme which bore upon secondary schools.

The result is, that there is at present no direct agricultural teaching in our secondary schools in the island—Potsdam, Wolmer's, and the Jamaica College have now competent Science Masters. We have all established laboratories, and the Jamaica College is enabled by proximity, Government consent, and the co-operation of the Island Chemist and his staff, to make use of the Government laboratory.

In addition, the Government secondary school at Montego Bay, which is controlled by the Board of Education, has appointed as its second Head-master a gentleman chosen for

his competence in science, and is making science its chief subject. There is thus a solid advance in the teaching of science in the island, and boys will leave our schools increasingly competent to benefit by the technical agricultural education which is being given by the staffs of the chemical and agricultural departments at the Government laboratory and Hope Gardens.

A plan has recently been drawn up by the Board of Agriculture for allowing boys from the secondary schools to join some of the classes—considered to be the ones fit for them—at the Government laboratory; but distance practically prevents any school except the Jamaica College from sending boys to it, and in our case no parent has yet expressed a wish for his son to take the course; so that the scheme at present remains a scheme only ready for use when required. The Head-master of the Montego Bay School has formulated a scheme of agricultural teaching in that school, which is to be introduced there, and which will, I hope, form the subject of a paper at some future conference. The other schools are unable, with the means at present at their disposal, to give direct agricultural teaching in the schools. The Jamaica College admits the students and some of the officials of the Agricultural Chemist's Department as residents; but their connexion with us is simply the residentiary one. The Chemist has nothing to do with their discipline out of teaching hours, and the college has nothing to do with their teaching.

I should like to see more direct agricultural work being done in the secondary schools than seems to me possible on our present lines; but the Montego Bay experiment may indicate methods which can be used. At least, the teaching in practical chemistry and physics is in the Jamaica schools in a very different position to what it was at the time of the first Conference; and they are sending out boys fit to take their part in the work. One old boy from my school, who received his scientific training at the Government laboratory, is now the Lecturer in Agricultural Science at the Government laboratory; two others, one trained at the Government laboratory and the other in England, have been in succession Science Masters at Wolmer's school, and one who went to Guelph has also taken part in the agricultural teaching at the Government Laboratory.

The difficulty in getting parents to give their sons training in scientific agriculture is partly due to the idea that it is not necessary; but mainly, as was pointed out at our first Conference by Father Carrol as existing in Trinidad, to the want of sufficiently attractive careers for trained agriculturists. That difficulty is gradually, though only gradually, being removed, and as it goes the demand for teaching in the schools will begin. The scientific teaching in the secondary schools and the appliances for it are enormously extended and improved. A few boys at present—only a few—leave us to take up the teaching given under the Board of Agriculture and the Island Chemist. With those developments, the present connexion of the secondary schools with direct agricultural teaching begins and ends.

AGRICULTURAL EDUCATION AT BARBADOS.

BY HIS LORDSHIP THE BISHOP OF BARBADOS AND THE WINDWARD ISLANDS.

Objection is sometimes made against Conferences on the ground that no practical good can result. The members have no vote and are therefore unable to put into practical shape any conclusions which may be arrived at.

Such objectors overlook the stimulus which intercourse with those who have the same end in view gives when they meet with one another. They compare notes and state the difficulties which they individually have met with, and may also be able to show how best such difficulties can be overcome. At any rate I shall deem my attendance at this Conference to have been of benefit if I can learn from others interested in educational work as I am myself, in what way we in Barbados might have done better than we have in furthering the work of the Imperial Department of Agriculture.

SECONDARY SCHOOLS.

For several years before I knew the colony of Barbados, a science class had been formed in connexion with Harrison College. The teaching, however, was mainly in the hands of one man, the Professor of Chemistry, and was almost entirely confined to chemistry. When the Imperial Department of Agriculture was commenced, the number of subjects taught in the science class was increased considerably, a Lecturer in Agricultural Science was provided, and in addition, exhibitions for competition were offered, varying in value from £15 to £26 a year.

The object in view was to give young men an education which would fit them to earn their livelihood by cultivation of the soil if they so determined, and so to discipline and train them mentally that they should come to their work with the sharpened intelligence and aptitude which a wide and sound education only could give. It was reasonably thought and hoped, that boys, who had passed through the science class, then specialized in agriculture, would use their knowledge in connexion with agriculture some way; and this hope has been to a great extent realized. I have not the exact figures to hand, but since the scheme was started, at least half a score boys have held exhibitions and have passed through the science and agricultural classes. They have been awarded certificates of competence, and at least 50 per cent. of the young men so trained are now engaged directly in agricultural work, and the remainder in work more or less in touch with it.

The benefit, however, has not been only direct in enabling boys to continue their education, in taking to the cultivation of the soils young men of disciplined mind, who have been

instructed generally and technically so that they would the better be able to recognize and utilize to the best advantage facts connected with their work; but the indirect benefits have been great also. One may not be able to tabulate and put them down in figures, but nobody can doubt but that a man with such training would be able to do his work better than one without. A comparative outsider can perceive a marked difference in the attitude of mind towards agricultural matters from what existed a few years ago.

I remember speaking to a planter, when the work of the Department was beginning, and he said: 'They seem to think we poor beggars cannot grow sugar. Why, it was grown here before any of them or those who sent them were born', and yet, I know that that man has availed himself in different ways of instruction given by the Department with respect to the working of his estate. Knowledge percolates downwards, and it may be some time before it touches the lowest grade of workers: but it is thought that the commencement was rightly made at the top.

In arranging for exhibitions and scientific instructors at Harrison College, the Imperial Department has accomplished useful work, and it is with the greatest regret that the Education Board received the announcement, that owing to the curtailment of the Imperial grant it would not be possible to nominate exhibitioners in the future. Therefore, our colony would be acting in a shortsighted way, and detrimental to its best interests, if they allow the scientific teaching now given, or the assistance now given to exhibitioners, to fall through.

The Government have granted £1,000 and given a suitable house for the residence of the Harrison College Masters, so that their rooms may be turned into work rooms for the teaching of science. The Board of Governors have arranged that every boy who enters the college for the future shall receive teaching in physics, botany, and chemistry (both practical and theoretical), as part of his ordinary school education; and that these subjects should not be confined, as now, to certain forms. The idea was, that the boys who had this grounding in the early days of their school life would be better able to specialize in after days, and would receive an all-round education, which would benefit them more than a mere technical training.

ELEMENTARY SCHOOLS.

The attempt to extend the knowledge of agriculture was not only made at the top, but the Department of Agriculture began instructing the teachers of elementary schools. A man cannot teach what he does not know. We have no training college for our teachers, and most of them know very little about plants or their culture. Arrangements were therefore made in 1900, that lectures should be given to the male teachers of elementary schools who cared to attend them. Lectures were given at Harrison College, instruction in the planting and management of plants was provided at Codrington House by the Agricultural Superintendent. In 1904, as it was difficult for all teachers to attend lectures in town, four centres were

formed and teachers of both sexes were allowed to attend. After the series of lectures had been completed an examination was held, and certificates of competency as well as book prizes were given to those who passed. In other ways, too, the Agricultural Department assisted by giving small grants for gardening tools for school gardens; by gifts of flower pots, boxes, etc., in which plants could be grown where it was not possible to secure sites for school gardens; *Tropical Readers* were presented to schools, etc., and the Education Board arranged that these should be the text-books on which the Inspector should base his examination.

It is obvious that a considerable improvement in the agricultural education of the children has been brought about. The children in our schools have most retentive memories, but their powers of observation are generally wanting. In many of the schools which I examined, they seemed not able to recognize the leaves of the most common plants, and they knew almost nothing of the manufacture of sugar, or as to how plants grow, etc. Now the conditions have changed, for in most schools there is an *atmosphere of agriculture* emanating from the Agricultural Department. It has touched planter, and teacher, and scholar, and now children grow plants at home and take an interest in the small garden plots around their homes.

The interest that the school children take in their plots is shown at the Agricultural Show held under the auspices of the Imperial Department at different places in the island. Provision is always made for the exhibition of plants and fruit grown by the children themselves (certified so by the clergyman of the parish and the teacher of their school). Last year no less than fifty-two prizes were allotted to the exhibits sent in by the children of the neighbourhood.

We have 166 elementary schools in the colony, and last year scholars were presented for examination by His Majesty's Inspector from forty-four schools. Eighteen schools had garden plots in cultivation.

These figures appear to be most satisfactory and hopeful, especially when circumstances which do not appear on the surface are taken into consideration.

Only a few of the teachers are acquainted with the principles of agriculture, and few of the parents care little about it. It is therefore impossible to change the feeling of the community in a year or so, and even now, in some cases, parents object to their children being employed in cultivating school plots for which they receive no immediate wage.

There is no waste land in Barbados. Every foot of land is cultivated and eagerly sought after, and in many cases it is not possible to secure land enough near a school for the purposes of a school garden, or even for a play-ground.

Then, further, the grant from the Government for elementary schools is fixed. A few years ago, the average number of passes on examination for the three R's was very small. Efforts were made to remedy this, with the result that standard

passes on the average attendance have greatly increased. The grant was fixed when the passes were very low, and now the percentage of passes has been raised the grant is the same. Last year it was not sufficent to pay for all the passes which were made, and in consequence, the earnings for passes as well as the stipends of teachers had to be lowered *pro rata*. The schools are thus paying for increased efficiency, and one can understand the reluctance of teachers to take up extra subjects and thus lessen their already small stipends. Since the fixing of the grant, agriculture and drawing have been added to the subjects required by the code, but no increase of grant has been made. It pays the teachers better to devote their energies to the three R's with the consequent neglect, or comparative neglect, of extras.

We have a compulsory attendance Act on the Statue-book, but it is not practicable to enforce it, mainly on account of want of funds to pay attendance officers. The attendance of children is therefore very irregular and unsatisfactory. The Agricultural Department has had many difficulties to contend with in Barbados, but in spite of all drawbacks, progress has been made, and as knowledge of, and interest in, agriculture are of vital importance, it will mean a considerable set back, if by the withdrawal of the grant or from any other cause, the help given to agriculture cannot be continued.

AGRICULTURAL EDUCATION IN SECONDARY SCHOOLS AT BARBADOS.

BY THE REV. H. A. DALTON, D.D.,

Head-master of Harrison College, Barbados.

It is a source of great regret to me that the exigencies of my work here have compelled me to decline the invitation, with which I was honoured, to be a representative of the colony of Barbados at the Agricultural Conference. I hope, however, I may be allowed to reach the ear of the Conference when it is dealing with educational subjects.

As I have come, since my arrival in Barbados, to learn something of the circumstances of the colony and of its educational needs and opportunities, nothing has struck me more than the value of the work which the Imperial Department of Agriculture has done for Barbados and for other islands through Harrison College. As this, owing to the diminution and prospective withdrawal of the Imperial Grant is a critical time, it may be well to place on record my sense of the great loss which would be caused, not merely to the college, but to the islands, if this work were to be given up, or even to be hindered in the extensions of which it is capable.

Harrison College is intimately connected with the Department of Science of the Government of Barbados. The laboratories of the Department are in the buildings of the college, and the scientific teaching of the boys is conducted by the officials of the department. In connexion with this, there has been formed under my predecessor an agricultural science class within the school, the lecturer for which is supplied by the Imperial Department of Agriculture. A considerable number of the boys in this class have been enabled to come to the college, or to complete their education in it, by means of exhibitions given by that Department. These exhibitions have been given partly to boys (preferably sons of planters or managers of plantations) in Barbados, and partly to boys whose earlier education has been obtained in the secondary schools of the Windward and Leeward Islands. The intention is to train boys to engage themselves in the agricultural operations of the West India Islands. No absolute guarantee can be enforced that a boy will do this. But the intention has been fulfilled to a considerable extent. Of ten Barbados exhibitioners who, having been elected in or since 1900, have left the school, five are engaged in plantation work; one is intending to take it up on a favourable opportunity; one is employed at the Government laboratory; one is a Druggist's assistant; the present employment of one is unknown; and one only is known to be engaged on work which is neither agricultural nor directly scientific. Of four exhibitioners from other islands, one is a teacher of science in St. Mary's College,

St. Lucia; one is employed in the Government laboratory at Antigua; the other two are in Antigua and St. Lucia respectively, but their employment is unknown to me.

Boys in this class go through a systematic course, at the close of which a diploma is obtained, in chemistry, physics, and biology, with especial reference to the requirements of cane plantation, sugar manufacture, and cotton planting. Boys are not allowed to join the class until they are fifteen or sixteen, and have gone through the lower and middle forms of the school (or a similar course elsewhere), and while they are in the class, they still have full teaching in mathematics, English, and a modern language.

I have gone into so much detail in order to show that we attempt to solve in the best way the problem how to give to a boy the technical and special instruction which will enable him to earn his living when he leaves school, and at the same time to secure some measure of that general knowledge, and, which is more important, of that cultivation of faculty, without which technical instruction is of little use. It is not necessary, to a Conference of agriculturists, to dwell upon the importance of scientific knowledge in agriculture; but it may be worth while to point out how greatly it is to the advantage of the colonies concerned that their agriculturists should be men who have in their boyhood received the best general education which can be given in the islands. In colonies which depend for their prosperity upon agriculture, and in which most of the members of the ruling classes are themselves engaged in it, the importance of this consideration is obvious. And to this end, I regard the Agricultural Department of Science at Harrison College as of very great value.

Any weakening of this work from loss of funds would be the more to be deplored at the present time, because, owing to the liberality of the Barbados Government, we are now making a very important extension of the general scientific work of the school. In future, every boy in the school, in the lower and middle forms, will go through a regular course of physics, botanical biology, and chemistry, as a part of his general education. This has an important bearing upon the subjects which interest the Conference, because boys who in future years join the agricultural science class will come to it with a groundwork of scientific knowledge and will be able to make further and more rapid progress in their technical subjects; and because the general diffusion of elementary acquaintance with natural science, and the interest in the world they live in, which will be thus inspired, will, it is hoped, attract a larger number of boys to the technical class than can now be expected, when a beginner in agricultural science has usually to be a beginner in all things.

In conclusion, I would say that the success and even the continuance of the work done here depend in very large measure, not only on the maintenance of an adequate teaching staff, but also on the maintenance of the exhibitions. The exhibitioners, carefully selected from this or other schools, in Barbados or elsewhere, are the boys to whom we look to keep up the intellectual standard of the class. They are the boys

whose circumstances give them the greatest possible stimulus to industry. And if it be carefully kept in view that the purpose of the exhibitions is to produce educated and intelligent planters, or teachers and investigators in agricultural science, it is through the exhibitioners far more than through others that we may look to the attainment of the objects towards which the Imperial Department of Agriculture has worked.

If the reduction or withdrawal of Imperial aid is to throw the colonies back upon local effort for the maintenance of this work, it is earnestly to be hoped that local effort, even though it may involve temporary and apparent self-sacrifice, will not be wanting.

SOME PROBLEMS OF AGRICULTURAL EDUCATION AT JAMAICA.

BY THE HON. H. H. COUSINS, M.A. (Oxon.), F.I.C., F.C.S.,

Government Analytical and Agricultural Chemist, Jamaica.

Considering the fact that it is only a little more than ten years since any general interest in the problems of adapting the educational systems of a country to the needs of the agricultural community has been shown by the English-speaking nations, it is not surprising that Jamaica should only recently have become alive to the practical bearings of this matter.

Whereas the United Kingdom and America are large manufacturing countries with populous centres of industrial activity, Jamaica has no industries other than those of an agricultural nature, and the problems of education should therefore be simpler, and the adaptation of our educational systems to the needs of the country be more easy of attainment than in the larger Anglo-Saxon communities with their complex industrial interests.

No one who has had any practical experience of the working of a system of agricultural education in any country would be able to deny that there are very great difficulties to be overcome, and the experience of the last five years in Jamaica has indicated that there are serious obstacles to progress which can only be surmounted by persistent and strenuous efforts.

To a stranger who came to this island impressed with the obvious fact that Jamaica is an agricultural country and its prosperity dependent upon the soil alone, it might appear certain that any system of education calculated to serve the agricultural interests of the country would be hailed with delight and find the warmest welcome from a grateful people. He would find, however, when putting his faith to the test of a practical trial, that much of the enthusiasm about agriculture and the advantages of agricultural education which finds vent in various writings and speeches is mere talk, and that the

Jamaican is an agriculturist from necessity and not from enthusiasm. The natural tendency of the social forces at work is that of encouraging the parasite upon husbandry rather than the husbandman himself.

With the labouring classes, the glamour of the highly polished boot and the crackling armour of the white shirt, stiffly cassava-starched, far outweigh the prosaic virtues of the machette and fork. The educated youth aspires to a life of languid leisure on a government stool or to a professional career. The strenuous life in the glare of the tropical sun makes great demands on bodily strength and comfort. If any man can secure a comfortable existence by a life of parasitic sustenance on the labour of others, we can not blame him for availing himself of the convenience, but there is already a deficiency of sustenance, and while the victim is lean, the hungry claimants of his substance are still leaner. In plain language, we have in Jamaica an excessive charge of the unproductive upon the productive, which it is the clear duty and interest of every patriotic and intelligent citizen to do his best to adjust.

It is from this standpoint that I would urge the direction of the whole of our efforts in agricultural education. Jamaica is a poor country and can only afford to pay for direct benefits. A prompt and immediate return for expenditure is one of the necessities of our position. We are therefore forced to aim at simple and direct means, and ambitious schemes are not within the sphere of practical achievement.

There are six spheres of operation in which some form of agricultural education is obviously needed in Jamaica :—

I. The Elementary Schools.
II. The Secondary Schools.
III. The Farm School.
IV. The Agricultural College.
V. The Peasant Proprietary.
VI. The Planters.

Operations in all but the third of these directions have now been commenced, and it is here proposed to offer some suggestions upon each of the six lines of effort.

THE ELEMENTARY SCHOOLS.

We are indebted to the Imperial Department of Agriculture for bringing the teaching of agriculture in the elementary schools of the island within the range of practical possibility. By sending to Jamaica a Lecturer in Agricultural Science in 1900, a start was made in the work of educating the teachers. Practically every teacher trained since that time has been through a course of study in elementary science and agriculture at the training colleges, while the special courses of instruction in agriculture for the teachers have now been held annually for six years. As regards the training of the teachers, the record of Jamaica stands very high and excels that of many English county authorities with much larger means at their disposal for the carrying on of this work. The difficulty hitherto has been

that of bringing the agricultural work into an adequate position in the operations of the schools. The Schools Department was doubtless wise to set its face against inefficient work and the introduction of agriculture as a school subject before the teachers were competent to treat it properly. So large a proportion of the teachers, however, are now qualified, and the code has been adapted to admit agriculture and the school garden as the essential features of the work of all rural schools.

There are two points which appear to merit the careful attention of those interested in this work:—

(1) To aim at the employment of the school garden as a means of illustrating the teaching given in the school, so as to vivify and impress the teaching given under the name of elementary science and agriculture.

(2) To raise the social status of manual labour, and to remove the absurd prejudices against it that are lurking amongst the newer generation of the educated youth of the country.

The recent progress made in this direction has been most marked, and it is possible to look forward to great advances during the next ten years in the adaptation of the elementary education of the island to its agricultural needs.

THE SECONDARY SCHOOLS.

With regard to the secondary schools of the island, it may be said that at present no actual agricultural teaching is given. On the other hand, through the persistent efforts of his Grace the Archbishop and the Schools Commission, the sciences introductory to agriculture are now being taught in a manner previously unthought of. Four schools possess laboratories, and undoubtedly during the past three or four years, science has become a far more important subject in the leading schools of the island. I am persuaded that this is the best line of work for the secondary schools to take up, as a sound training in elementary science is of the greatest value to a student entering an agricultural college, while agriculture can hardly be treated as a subject of the ordinary school curriculum without degenerating into cram or pure theory.

THE FARM SCHOOL.

This I regard as a great necessity of the time and one calculated to be of the greatest direct benefit to the progress of the smaller agriculturists upon whom so large a share of our exports depends. Attempts have been made on two or three occasions to start such an institution, but without success.

I am convinced from experience gained of candidates desirous of taking up the higher course of agricultural training, that there are a very large number of young men in the island for whom such an institution as a farm school would be of the greatest benefit.

Practical work in dairying, the management of live stock, veterinary work, carpentry, and instruction in the practical cultivation, curing and packing of our chief crops, should be

provided in a suitable farm attached to the school. The boys should work at least half their time on the farm, receiving pay for the work done.

I am of opinion that such an institution could be founded at Hope without involving any serious expense. The utilization of the Merrick Trust Fund for this purpose has already been suggested; and I think the matter is of such pressing moment to the interests of a very important section of the agricultural community that it should again be considered by the Government on its merits.

There is no class in the community so desirous of learning and anxious to avail itself of any help obtainable as the lower middle-class.

I have had to refuse a large number of applicants admission to the laboratory course on account of deficient general education, among whom were many who undoubtedly would have derived great benefit from a Farm school.

This institution should provide education in writing, arithmetic, elementary mathematics and book-keeping, and the science of plant growth and nutrition treated very simply. The chief subject should be tropical agriculture treated on simple and yet thoroughly practical lines.

THE AGRICULTURAL COLLEGE.

Some attempts to provide a higher course of agricultural education has been carried out by my department during the past four years. With the assistance of the Lecturer in Agriculture, the Assistant Superintendent at the Experiment Station, and some outside assistance from the Science Master of the Jamaica College in book keeping, and from Dr. Gibb, D.V.S., on veterinary medicine, a general course is provided upon which the diploma of the Board of Agriculture is awarded.

Three scholarships of the value of £36 each are awarded annually by the Board of Agriculture.

This enterprise has been the means of training a good many young men, and has already produced workers who are advancing the interests of the island. Our chief difficulty has been that of the inadequate general education of the applicants for admission. Apart from the few brilliant boys who head the Empire in the Cambride local examinations, there appears to be a very low standard of secondary education among the boys of the island generally.

The recent advances in the teaching of science to which I have already referred with gratification should do a good deal to improve the educational standard of our students in the near future.

The classical and non-agricultural studies in the schools are so heavily endowed with the Jamaica and Rhodes Scholarships that it is not surprising that any boy with ability should scorn to turn his thoughts to the study of agriculture.

An attempt to rectify this unfair balance of advantages was made by the Government during the last session of the

Legislative Council, by the introduction of a measure for appropriating a portion of the Jamaica scholarship for agriculture.

It is to be regretted that this proposal was defeated, and that the unequal endowment should still persist to the detriment of a study on which the material interests of the colony are so dependent.

It is to be hoped that steps may yet be taken to vitalize and encourage this important branch of agricultural education, and that when the colony is in a position to start an agricultural department, an efficient and adequately endowed agricultural college for the education of the leaders of agricultural enterprise in the West Indian Colonies may be provided.

THE PEASANT PROPRIETARY.

The work being done by the Agricultural Instructors and by the Agricultural Society with this important section of the agricultural community is being dealt with by those directly concerned. The results already obtained have been very encouraging. As a matter of general policy I would advocate the employment of the best men only, and the provision of a rate of pay calculated to encourage and retain their services.

More money could certainly be spent on this work to advantage.

THE PLANTERS.

To assist the planter, the highest resources of experimental science are desirable and necessary.

As regards the sugar planters, the Sugar Experiment Station has been founded to provide assistance in the study of cane varieties, manures, and the special problems of rum manufacture. Special courses of instruction for distillers and sugar makers are also provided.

All the agencies of the agricultural services are designed to be of use to the planters in the study of local problems of an agricultural nature, and it is evident that great progress has been made during the past five years in all branches of this work in Jamaica.

GENERAL SCIENCE IN ELEMENTARY SCHOOLS OF JAMAICA.

BY E. J. WORTLEY, F.C.S.,

Lecturer in Agricultural Science, Jamaica.

Those interested in agricultural and scientific education in Jamaica will value the opportunity of obtaining the advice of the members of this Conference who have been working and progressing in neighbouring colonies under conditions somewhat similar to ours.

The great development that has taken place in agricultural teaching in the elementary schools—especially in the fostering of school gardens—has already been shown. It is proposed to put forward certain suggestions for strengthening the general science (including, of course, the principles of agriculture) in the school-room.

Much misunderstanding exists as to exactly what is done, and many baseless objections are raised to science being taught at all. The educational value of this subject, however, warrants the consideration of how the maximum good, possible under present conditions, may be obtained by a constructive policy of action. Many of our outside critics do not know what is meant by science as taught in the schools. The term itself is indeed likely to suggest an overburdening of both pupil and teacher in an elementary school, but when the syllabus in the code is consulted, it will be found that the science lessons include only simple lessons on the life of animals common to Jamaica; the study of plants as growing things; together with lessons on a few main laws of health (e.g., necessity for wholesome food, pure water, airy dwellings, bodily cleanliness). The 'Notes and Suggestions,' two paragraphs of which I quote below, reveal the manner in which it is desired to have this subject taught.

'The lessons must, whenever possible, be illustrated by actual objects, specimens, pictures, diagrams, black-board drawings or clay models.

'Children should be encouraged to bring with them to the lesson illustrative specimens which they have collected or obtained from friends.'

The agricultural side of the work is the predominant feature, introducing familiar elements, and thus bringing the subject to the level of the children. This tends to turn their thoughts in the direction of a subject that is vital to prosperity.

Much has been written and said about the true aim of education. The child should no longer be 'crammed to a state of mental biliousness.' Men and women are wanted able to adapt themselves to new circumstances; determined to take pains, and capable of doing so. It may not be out of place to specify some forms of improvement that will be indirectly brought about by such a system of true education.

The labourer will appreciate the use of a straight line and will take care of his tools. The carpenter will with forethought plan his work and save the now inevitable 'patch'; joints will not depend upon putty to ensure their being flush. In the kitchen, careful methods of measurement will be adopted. The dressmaker will accurately follow a pattern, working by measurement. The small proprietor will conserve his manure, will not burn his lands, and will learn from his more successful neighbours, or by experimenting himself, how to grow, care, and handle his produce to the best advantage. The clerk in the Government service or mercantile business will win promotion by his reliability and energy.

A good teacher will make all subjects educational in the true sense of the word, but it is claimed, with conviction, that the subjects under the head of science come *facile princeps* in developing the faculties of the child. Moreover, it will be noted that drawing and composition—as the record of the child's personal observation and the exercise of his reasoning powers—are included. There is evidence to warrant the statement that the teacher who pays special attention to the teaching of science as directed by the code, develops habits of orderly thought about, and careful preparation for, all his teaching—his work being generally thus leavened with an educational bias pregnant with possibilities.

The mental discipline derived from such training will be such as to develop in the individual the power necessary to grasp what is desirable to accomplish the task successfully. If such hopes appear to any one unattainable and the grounds for entertaining them untenable, evidence to the contrary may be obtained from School Inspector, teacher, and employer. Instances of oral examination, of written work, of children's collections, of their manual work have come under the writer's notice, which testify to the good results that are being obtained.

It cannot but be recognized however, that there is now a tendency to neglect general science in favour of practical work in the school garden, and also insufficient preparation is given by many teachers to their science. Three School Inspectors write respectively, that:—

'Brains have not been racked to devise, or pains taken to prepare new experiments'; 'the principles of agriculture must not, and cannot, be taught almost to the exclusion of the other branches of elementary science indicated in the syllabus,' and 'in some schools the work in science is very creditable, but those in which there is evidence of the subject having been taught by object-lessons and practical experiments still form a small minority.'

Such difficulties are not peculiar to Jamaica, for they are similar to those the Board of Education in England are endeavouring to overcome. In spite of all that has been, and is being done, we must make still more strenuous efforts to encourage among the children in our schools that action which begets knowledge, and the knowledge that begets action.

The following suggestions are offered in the belief that, if adopted, they will contribute to the more efficient teaching of this subject, with the accompanying advantages to the schools. Some of these are indeed now in force and are giving good results, but the hope is that if new provisions are made for fostering this work with the concurrence and approval of persons of such experience as the members of this Conference, they will be more generally accepted, and will become more living and potent realities in the educational work of this country.

PRACTICAL WORK IN SCHOOLS AND TRAINING COLLEGES.

It is suggested that more or less central schools (e.g., in districts where branches of the Jamaica Union of Teachers meet) should be selected with the approval of the School Inspector for that district and given a small grant—or if that be impossible, sound advice and plenty of encouragement—to specialize in the science work as taught in the school-room, 'through hand and head.' These teachers would have to pay special attention to their science library, to collections, to drawings, and to diagrams. The Hon. Superintending Inspector of Schools, in a paper read before the Conference of 1901, drew attention to the very strong imitative faculty that exists among our people, and stated that of the ten school gardens then in existence, five were within a radius of 10 miles, and three within a radius of 2. Now there are over 200. Similar development may be expected in the number of schools doing sound work connecting theory and practice, exalting theory by putting it into practice, and illuminating practice with theory—and further, to ensure that more attention should be paid to practical work (e.g., collections, drawings, diagrams, records, observations), it is suggested that special stress be laid on this side of the work at the annual examination in science of the students at training colleges, and of the pupil-teachers.

LITERATURE FOR THE LIBRARY.

'Throw text-books away' is the modern advice sometimes heard. I venture to assert that this idea has already done considerable damage ; it is not the use, but the abuse, of books that must be prevented. The teacher who is useless with the aid of books will be dangerous without them. Teachers should be encouraged to collect and consult books, pamphlets, etc., the books being made levers to self-activity, to guide on right lines. I quote the remarks of an Inspector of Schools taken from the Annual Report of the Educational Department for 1906 :—

'The lessons in elementary science and agriculture mostly suffer from want of preparation and are deficient in matter. This means that the *Tropical Readers* are not made sufficient use of by teachers or children as text-books. In the future I propose to acquire acquaintance with the information which these books afford with more exactitude than in the past.'

Prof. Huxley has most aptly put the matter in the following sentence: 'What men need is as much knowledge as they can assimilate and organize into a train for action.' It is suggested that a list might be prepared and sent to all teachers, in order to show what literature it is desirable for them to use. The fact that out of some fifty teachers questioned, only one had seen the excellent pamphlet on the 'General Treatment of Insect Pests' issued by the Imperial Department of Agriculture, shows the necessity for pushing the supply of literature. The *Tropical Readers* now in common use unfortunately do not pay sufficient attention to practical work. It seems most desirable that notes relating to their subject-matter and setting out clearly a number of specific examples of what the pupil should draw, collect, prove by experiment, observe, and record, should be prepared.

Teachers might be encouraged to write and ask for explanations of difficulties as they arise, especially in the more advanced part of their science work, and it has been suggested that a paper should be prepared and sent to teachers in order to engage their active sympathies with science work, conducted on the most educational lines. It should show fully and clearly what are the advantages of teaching the subject, what the difficulties are, and how they may be overcome.

In conclusion, I would repeat how important is the science work in the school-room. There must the child learn principles and fundamental truths. Experience has proved that full discussion of 'the why and the wherefore' is the sheet-anchor of work in the school garden. On the other hand, care has to be taken to guard against class-room work being too theoreticial, and in order to prevent this, I have brought forward certain suggestions, trusting that these will meet with the approval and support of those present.

AGRICULTURE IN ELEMENTARY SCHOOLS OF JAMAICA.

BY THE HON. T. CAPPER, B.A., B.Sc.,

Superintending Inspector of Schools, Jamaica.

Six years have passed since I last had the opportunity of being present at one of these Agricultural Conferences, and on this occasion I propose to bring forward information, brought up to date, with reference to the teaching of the principles of agriculture in elementary schools at Jamaica. I shall confine myself mainly to facts; the theory of the subject has been or will be fully and ably expounded by others. For a good deal of the material of this paper I must express my indebtedness to the Inspectors on my staff, who visited the school gardens in their districts every year, and to Mr. A. B. McFarlane, Principal of the Mico Institution, to whom the chief credit attaching to the successful domestic and disciplinary management of the annual agricultural courses is undoubtedly due. Credit is also due to the Director of Public Gardens and Plantations for making arrangements for lectures, for the preparation of the annual pamphlet, and for general supervision of the courses.

The experience of the last six years has only strengthened the conviction which I expressed in 1901, that it is impossible to teach agriculture in elementary schools as a trade is taught to an apprentice, and that the mere attempt to do such a thing would be fatal to real educational efficiency. It might seem unnecessary to dwell upon what will no doubt be regarded by many as a truism; but the old heresy still crops up, and we still meet those who consider that the chief and best use to which the period of a child's school life can be put is to direct all his activities, mental and physical, towards the one object of making him a good agricultural labourer. It is true, nevertheless, that in the school lessons much will be learnt that will be helpful in home work. Many a boy of fourteen will have learnt from the agricultural instruction in the school, in connexion with his practical work in the school garden, and from his observation, guided and trained by his teacher, much valuable information and skill that the man of forty may not have gained from his own experience as a practical agriculturist. This is one of the chief objects to be obtained by the establishment of school gardens.

The teaching in the primary schools of the elementary principles upon which agriculture and horticulture depend, has advanced greatly in the period under review. Nearly half our teachers (about 300) have attended the annual agricultural course, and a number of them more than once; and taking into account those who have passed through the training colleges since agricultural science has been introduced into the curriculum, a considerable majority of the whole number of teachers have received training in this subject. This training has, according to the unanimous testimony of the Inspectors, had a most marked effect upon the teaching in the schools. Numer-

ous changes have been made in the regulations in order to encourage and facilitate the establishment of school gardens. The ¼ acre of land orginally insisted upon having been reduced to a square chain, a good deal of time devoted to the work in the gardens may now be part of the ordinary school hours. Grants for tools are now made as soon as a suitable piece of land has been properly fenced and prepared, instead of being delayed until after a year's successful work; and the conditions as to the possession of the land used have been made less rigorous.

At the same time, the weight given in the primary schools to the teaching of elementary science. with special reference to agriculture, which includes the instruction given in the school gardens, has been in country schools, which are more than nine-tenths of the whole number, considerably increased. As a result, the number of schools receiving special grants for practical agriculture and horticulture has increased from six in 1900, to ninety-two in 1906, and the amount of special grants awarded, from £32 in the former year to £227 in the latter. In addition to these ninety-two schools, there are seventy-nine to which advance grants have been made for tools, and these seventy-nine are working for special grants in the present year. These advance grants for tools, made under a recent amendment to the code, have amounted to about £100 already.

These gardens, besides the annual visits from the Inspectors, are visited by the Agricultural Instructors, whose function is to give hints, suggestions, and advice; and the Inspectors are assisted in estimating the value of work done by observing the extent to which this advice is followed and the suggestions are carried out. For two years now, the sum of £50 has been devoted in each year to the establishment of model school gardens in selected centres, under the direction of the Agricultural Department, for the guidance of the teachers in the surrounding districts. There are now nineteen of these gardens.

It is under contemplation to appoint an officer with special qualifications and experience to visit schools which are not visited by the Instructors. A circular has just been issued to all teachers, pointing out the necessity of having a plan of the school garden, correctly drawn to scale, showing boundaries, adjacent buildings and roads, garden, footpaths and beds, and showing what crops it is intended to cultivate, and this plan must be approved by the Superintending Inspector of Schools and the Director of Public Gardens, before a grant is made for the commencement of the garden.

Stress is laid upon satisfactory fencing, a proper gate, and other preliminaries. These rules have not up to now been rigidly insisted upon; but it is felt that the time has come when all school gardens applying for grants should be required to comply with them.

I may mention that besides the school gardens qualifying for the special grants under the code, there are a large number of small garden plots which do not meet the requirements of the code, but which in many cases are very creditable to the

teachers, and serve their purpose admirably. It is worthy of note that some of the best of the school gardens are maintained by women teachers. Some gardens are so well managed that they attract the notice of the agriculturists of the neighbourhood and are recognized as object-lessons of value.

Some of the principal difficulties experienced by teachers in starting and conducting a school garden may be here briefly referred to.

The fencing of the garden is a great difficulty in most places, owing to the costliness of good permanent fences, such as will keep out small stock as well as horses and cattle. The best way of meeting this difficulty seems to be to erect wattle or bamboo fences, and keep them constantly repaired, renewing them entirely when necessary. This gives continued practice and experience to all the scholars who pass through the school, at very little expense.

In some places the soil is so hard that children's labour can make little impression upon it, and some initial outlay for outside labour is necessary. In the model gardens this is defrayed out of the special grant. In some cases the only land available is on a steep slope, and some managers and teachers think a school garden impossible under such circumstances. A simple system of terracing, at no great cost either in money or labour, has proved effective in many cases: the beds can be manured, they are well drained, and yet the loss by wash due to heavy rains is prevented. In many of our schools this work has been done or commenced with very satisfactory results. In other places the only land available, though level, consists of stiff clay, or marsh, and in each case deep drains are necessary, the digging of which it is difficult to provide for without getting outside labour. In one school garden there is a trench some 70 yards in length, 4 feet deep at the outlet, and as many feet in width. Thanks to this trench and its branches, a piece of land previously considered irreclaimable owing to its marshy nature, is now being converted into a fertile school garden and presents an object-lesson for a whole district, as bananas that formerly only produced sixes, now have 'straight' bunches.

In comparatively few localities can an ideal plot of land be secured for a school garden, but even in the most unpromising plots something, often a good deal, can be done, if the necessary labour be expended. It must always be remembered that even in these unpromising places the inhabitants have to make their living out of the soil. Excellent work has been done in some places by the production of good crops on land previously supposed to be incapable of cultivation.

In Jamaica, all boys over eleven are required to work and be taught in the school gardens, whilst the introduction of the girls and smaller boys is not discouraged. In large schools, the number the teacher has on his hands is sometimes quite unmanageable, and the beds get trodden down, and the edges of the path obliterated; whilst most of the children supposed to be under instruction are learning nothing. No rule has yet been framed, restricting the

number that can be taught on a given area, but it would seem that even at the cost of halving or dividing by three the number of hours of practical teaching nominally received by each child in the year, the large classes will have to be divided into two or three sections to be taken at different times; and in extreme cases, the girls and smaller boys will have to be excluded.

There seems to be still great difficulty in securing that a close connexion shall be maintained between the lessons of science and nature study and the practical work in the garden. The lessons in the school-room should be used to enforce the rules for practical work in the garden, and the work and processes of nature in the garden to illustrate the lessons in the class-room. It is in no subject more important that children should not be accustomed to set forms of questions and answers which they learn mechanically without using their brains; yet there are perhaps none in which this is more common. Children who are very glib with rote answers are often entirely at a loss when questions requiring ever so little thought are put to them. It may be remarked that even where there is a school garden great use may be advantageously made in the school-room of bottles or boxes with varieties of soil.

On a general review of the work that has been accomplished during the last six years, I think we may instance that we have clearly gained a general recognition of the importance of drainage, tillage, and the upturning of the soil by forking; some idea of the value of manures; the commencement of an appreciation of the need for proper lining out and order; the use of plants, etc., as objects to illustrate lessons, with increased attention to experiments; and in some schools, a certain amount of serviceable knowledge of pruning and budding.

What is mainly wanted now is the power of adapting general principles and model plans to local conditions, and of avoiding, by keeping up variety in their work, the tendency to get into a groove after leaving college or returning from an agricultural course. There are other difficulties, such as the absence of suitable practical text-books containing the substance of what they have learnt at college or from the courses, with a little supplementary information and practical suggestions—a want which will be to a large extent met by a little book on school gardens by Mr. J. R. Williams of this Department, which is now in the printers' hands, and will, I hope and expect, when published, be found of great value to all teachers in the West Indies. Thereafter, from time to time, it may possibly be found desirable and practicable for the Department of Agriculture to issue leaflets on special points as is done by the Agricultural Department at Washington and elsewhere.

Sir Daniel Morris has suggested that it might be possible to place some interesting exhibits in the Conference room. I regret that I have found myself unable to adopt his suggestion, as the only exhibit that I can think of that would be of much value or interest would be a school garden itself.

The annual courses of instruction in theoretical and practical agriculture for teachers in charge of elementary schools in the island of Jamaica were commenced in the year 1900. There have been in all seven courses, with an average of sixty teachers in attendance.

The Lecturer in elementary science was for the first few years the officer sent to Jamaica for that purpose by the Imperial Commissioner of Agriculture for the West Indies, but he is now appointed by the local Government. The Instructors in practical agriculture are under the direction of the Board of Agriculture.

The Board of Directors of the Mico Training College have year by year placed the college at the disposal of the Government, and the teachers are boarded and lodged during the whole course, which lasts about a month, free of cost to themselves. They are also provided with free railway travelling.

The lectures are delivered in the college, and each teacher is required to fork, dig, and otherwise prepare for the purpose of cultivation, a plot of ground, measuring 8 yards by 6 on the college premises. The women teachers do no forking, etc. The teachers, men and women, are conveyed to and from Hope Gardens by electric car three mornings each week for the purpose of receiving instruction in accordance with the syllabus, of which a copy will be sent to any member of the Conference who is interested in the subject, and cares to write for it, by the Director of Public Gardens and Plantations.

Lectures are delivered at the college three afternoons each week on subjects of special interest to the teachers. These lectures are generally, but not necessarily, connected with agriculture, and they are open to the public, and for the past few years a course of instruction in drawing and colour work on kindergarten principles, as set out in the schedule to the code of regulations, has been added to the agricultural course.

There is evidence on all sides of the value of these courses. It must be remembered that nearly every teacher in Jamaica has been brought up in agricultural surroundings, and has some considerable knowledge of agriculture. These courses afford them an excellent opportunity not only of extending their knowledge, but also of correcting any wrong methods they may heretofore have been in the habit of putting into practice. The students af the Mico Training College are in residence for either two or three years. During the whole course of their training, instruction in theoretical and practical agriculture is given week by week in accordance with the curriculum laid down in the education code.

The practical work is done in the college grounds, but the students have the great advantage of being allowed to attend Hope Gardens on Saturday mornings for instruction, under experts, in pruning, budding, etc., while the theoretical work is done in the Mico class-rooms, and is in charge of the Assistant to the Island Chemist.

AGRICULTURAL TEACHING IN ELEMENTARY SCHOOLS OF BARBADOS.

BY THE REV. J. E. REECE, M.A., Barbados.

The following information with respect to the teaching of agriculture in the elementary schools of Barbados has been submitted by the Rev. J. E. Reece, M.A., Inspector of Schools, Barbados.

During the year 1906, the subject was taken up in forty-four schools, and there were some eighteen school gardens. At a few more schools plants grown in pots or boxes were exhibited. The serious drought which took place in the early part of last year discouraged some teachers, who had on a former occasion exhibited plants grown by their pupils. The subject does not receive the attention that it demands, and chiefly for these reasons: (1) The grant for elementary education is limited to £11,000, and since this limit was fixed, the teaching of agriculture and drawing has been added to our code, but no extra grant has been made for teaching these extra subjects. (2) There is no Compulsory Education Act in force here, and the attendance of the children is very irregular; but the Education Board expect that a certain percentage of passes should be gained in the three R's, and bring pressure to bear on teachers who do not reach the required percentage. (3) The teachers therefore are compelled to confine the attention of the majority of their children to the study of the three R's so as to obtain passes; otherwise they would suffer financially, and receive an unsatisfactory report from the Inspector.

The following portion of the Report on Elementary Schools for 1905, gives information in respect to agricultural instruction :—

'The work in this important subject has been maintained during the year, and there are signs of progress. Fifty-one boys' schools and three girls' schools, the same as in 1904, presented children at the annual examinations in the Object-lessons based on the text of the *Tropical Readers* and *Nature Teaching*. About one-third of these also showed either school gardens under cultivation, or plants growing in pots or boxes. The number of passes obtained was not as high as last year's figure, being only 674 as against 820. But the school gardens are decidedly better managed than before, and the number of them has increased to twenty-one. These received grants of implements from the Imperial Department of Agriculture ; and twenty other schools received pots and boxes in which to cultivate plants. At the Bushy Park Exhibition on December 5, it was generally acknowledged that the exhibits from the schools were of a higher standard than those at previous shows, and that they evinced more care and attention on the part of the children. A boy from St Jude's won a prize for grafting, and the Society's Boys' School and Mount Tabor Boys' received diplomas from the Commissioner of Agriculture for their exhibits.

We must acknowledge that we had some difficulty to induce the teachers to take up this subject heartily. They are discouraged by the fact that after the legislative grant had been limited to £11,000 for their teaching the ordinary subjects in which they had received training, they have been called upon to take up in their schools two other subjects, agriculture and drawing, in which they had previously received no preparation ; and no additional grant has been made to them for the trouble and expense they may have in preparing themselves to teach these two subjects. They have to teach more subjects on reduced salaries ; and in case they fail to teach them, they lose a part of their small salaries. That anything has been done by them in this subject of agricultural instruction is to be attributed entirely to the encouragement and substantial assistance given by the Imperial Department of Agriculture.'

The following résumé of the efforts of the Imperial Department of Agriculture towards encouraging the teaching of agriculture in the elementary schools of Barbados has been prepared by Mr. J. A. Carrington, Assistant Inspector of Schools :—

Immediately on the inauguration of the Imperial Department of Agriculture, arrangements were made for assistance to be given to the instruction of the children attending the elementary schools of Barbados in the first principles of agriculture.

In the first instance, classes of male teachers were organized, and lectures on agricultural science were delivered by various officers of the Department. In 1899, and the two following years, these lectures were given during the vacations at Harrison College by the Assistant to the Island Professor of Chemistry ; and the Superintendent of Sugar-cane Experiments invited the teachers to Codrington House and gave them object-lessons in plant cultivation.

In 1902 and the following year, the Lecturer in Agricultural Science attached to Harrison College, gave lectures to teachers at four different centres in the country districts. These were attended by the male and female teachers around.

After each course of lectures, examinations were held, and those teachers who passed with highest merit were awarded book prizes. Presentations of a large number of the *Tropical Readers* were also made to the Education Department, for distribution among the schools which were in charge of the teachers who had attended the lectures.

In 1904, further aid was rendered to the schools by the Imperial Department of Agriculture in the shape of a gift of gardening implements for schools that found it feasible to establish school gardens, and of pots and boxes to such schools as were unable to possess school gardens.

Money grants were made in 1901 to teachers on behalf of pupils who passed an examination on the text of the *Tropical Readers*; and at the annual Agricultural Show held by the Imperial Department, there is always a section for school-

childrens' exhibits. Fifty-two prizes were offered, with possible additions in the case of articles of merit which may not have been called for by the schedule.

Three years ago, at the suggestion of the Imperial Commissioner, the Education Board made agricultural instruction one of the ordinary subjects of the annual examination in boys' schools with a higher grant to be awarded where a school garden is kept up by the work of the pupils, and a lower grant where the course of instruction is limited to the study of the *Tropical Readers* with object-lessons.

That these efforts have been productive of good practical results is evident. Over 30 per cent. of the boys' schools in the country districts have established and maintained gardens during the past three years. Those who are acquainted with the conditions of Barbados will understand how difficult it is to obtain land for a school, more than the small plot actually necessary for the building. Most schools have no open land around them.

Again, the school-children of the present time show that they esteem agricultural work, at least in the form of gardening, much better than their predecessors did, by the manner in which they vie with each other when at school garden work. At the agricultural shows, hundreds of plants in pots and boxes, and large quantities of garden produce, all of which are testified by the teachers and clergymen to have been grown by the pupils whose names are attached to the various exhibits, are a proof that a very healthy influence has been brought to bear on the rising generation of our peasantry through the Imperial Department of Agriculture.

AN AGRICULTURAL AND INDUSTRIAL EXPERIMENT.

BY THE REV. FATHER COLLINS, Jamaica.

In the year 1897, Bishop Gordon began an Agricultural and Industrial Experiment which, though an apparent failure, is worthy of consideration, and at least deserves a place in the literature of the development of the island in recent years.

It is agreed that the riches of Jamaica are in the soil. It is also pretty well agreed that there is a tendency among our people to leave the cultivation of the soil, and to crowd into Kingston, or into the smaller towns to the detriment of good order and morality. It was therefore thought that if the waif and the stray of the towns, and that element of the hill population which is inclined to leave the country, were got hold of in time and taught to farm intelligently, and if some scheme were elaborated to get them back to the soil by developing in them an appreciation and love for agriculture, a great service would be rendered to the colony, and a step made towards bettering the moral condition of our population. These were some of the reasons which led Bishop Gordon to undertake the experiment which I shall now try to describe.

The Roman Catholic Vicariate in Jamaica owns a pen of about 70 acres of land in the parish of St. Catherine, and about 1 mile to the south-east of Spanish Town. This pen was a gift to the Mission. It was given over to the Sisters of Mercy from Alpha, on condition that they would maintain fifty orphans there. As the pen was ruinate when they took it over, a small capital was necessary to make a beginning. This was subscribed by generous benefactors. The Sisters began by taking only a few boys. As more than one-half the pen is good banana land, bananas were planted, and as a matter of course, such vegetables as were needed for the maintenance of the boys and staff. The staff consisted of two Sisters and three girls who had been trained by them at Alpha. A headman was also employed to superintend the boys at work.

At the time of the hurricane in 1903 there were seventy boys in the orphanage, one-half of whom were under eight years of age and therefore of little use. Forty acres were planted in bananas, which during the good months of the year yielded a revenue of about £50 per month, and during the bad months, seven in number, about £20 per month.

The boys were kept under kind but good, wholesome discipline, and got two hours of the class-room every day. The older boys, especially some of them, were excellent aids in helping to keep the smaller ones in order. They liked to be trusted with some authority and rarely abused the trust put in them. Nearly all the work connected with the planting and cultivation of the bananas and vegetables, except the heavy work, was done by the boys. They were taken from any age after babyhood, and kept until they were sixteen, when they were at liberty to go, or to stay at a fixed wage.

It was discovered before the orphanage was long in existence that, owing to the trouble from the parents of this class of children, it was necessary to get the children indentured. As will appear to any one, this kind of work is philanthropic, and therefore there was no question of making money by it, beyond the money necessary to keep up the experiment. The total cost of each boy was about 6s. per day. The hurricane came in 1903, and owing to the Bishop's declining health, as well perhaps as to the fact that too many boys had been taken in for the size of the place, the Sisters had to be withdrawn.

It is clear to me that the Spanish Town farm could easily support fifty boys, and leave a small margin of profit every year to be laid aside against a rainy day. The hurricane is held responsible for the withdrawal of the Sisters and the failure of this experiment, but the true causes of the failure were the failing health of Bishop Gordon and the reception into the orphanage of too many small children. If the Bishop's health had been good, and if a little more judgement had been used in selecting the boys, never permitting the number to pass beyond fifty, to-day the Spanish Town Orphanage Experiment would be recorded as a genuine success.

Several of the boys of the orphanage are to-day in good positions and reflect credit on their teachers and benefactors.

Now about the second stage of this experiment. The object of the experiment was to get the boys back on the soil. As the Roman Catholic Mission in Jamaica owns a pen, 'Reading,' of 400 acres, about 5 miles outside of Montego Bay in the parish of St. James, it was decided that after the boys attained the age of sixteen they were to be transferred to Reading where they were to spend three or four years in a more scientific study of agriculture, and where their characters would be strengthened and self-reliance developed by a more liberal discipline.

The Salesian Fathers and Brothers were entrusted with the conduct of this part of the experiment. This part of the experiment also met with little success. The Salesians were strangers in Jamaica and everything was new to them. Reading was ruinate land and quite unsuited to farm land. It is really a dyewood, lime, and pimento property, and not a farm at all. Probably at the time the experiment was tried there were not more than 25 acres of farm land in the whole pen. There were no stock, no outfit of any kind for the work, and no capital. The result was that the four Salesians could scarcely scrape together enough to live on. The pimento trees had been murdered, and every fit stick of logwood cut. The causes of failure here were clearly the unsuitability of the land for the object in view, and the absence of some capital to start with. The Salesians, however, kept on a few boys who have since given a good account of themselves.

To illustrate what might have happened at this second stage of the experiment, I need only say that the gross receipts of Reading pen were about £200 the first year the Salesians had it, over £400 the second, over £600 the third, and over £800

the fourth year. I need not here enter into the value of their intelligent ideas on cultivation, which have become the common property of their neighbours.

The third and last step in Bishop Gordon's project was to place the boys who gave evidence of trustworthiness on a farm in St. Mary's parish, where he purchased 1,400 acres. As the first and second experiments were a preparation for the third, their failure made the third impossible.

On looking over the causes of the failure, it was felt that if a large and suitable farm could be found near Kingston and purchased for this splendid project of Bishop Gordon, his failures might be turned into successes, and therefore the well-known property, Bushy Park, was acquired last September with a view of carrying out Bishop Gordon's plans. It appears to have advantages which all the three properties named above lack. It is all farm land, near a good market, accessible by railroad, by sea, and by main road, and is extensive enough for any further developments time may suggest.

SCHOOL GARDENS AS AN EDUCATIONAL MEDIUM.

BY P. W. MURRAY, Superintendent of Sugar-cane Experiments, Jamaica.

All those who have had opportunities of investigating the educational systems in vogue in the United States of America will appreciate that agriculture in theory and practice claims no secondary place in men's thoughts and activities. The enlightened system of school gardens which has proved of such great advantage for the instruction of the boys and girls of the United States might, with advantage, be introduced into the educational systems in vogue throughout the West India Islands.

In all branches of education, the very highest importance is attached to an early beginning, when the mind is most plastic and impressionable. In carrying this principle into agricultural training, as is contemplated by school gardens, we are adopting the method which experience has established to be the most promising and efficient.

It is admitted that whatever minor branches of industry may be pursued in these colonies, the main effort of the general population must lie in the direction of winning from the soil the valuable products which it is so well adapted to yield, and it follows from these facts, that bringing the minds of our juvenile population into contact with the nature and possibilities of plant life in an enlightened and practical manner, must be fruitful in large, general, beneficial results.

The Government of Jamaica has not been neglectful of the advantages to the material and moral welfare of the community, for efforts have been made to interest and instruct the children connected with the several elementary schools in problems of plant life, but there are few persons, if any, who calmly considered this whole question, that will not come to the conclusion that some further efforts are needed if large abiding advantages are to be obtained.

Organizations exist throughout the country to further the important interest of agriculture; and the Hope Gardens, the Agricultural Experiment Station, Sugar Experiment Station, and Agricultural College at the Government Laboratory, as well as the Board of Agriculture and Agricultural Society, have been gradually but surely bringing about important changes which are telling favourably on the general welfare of the island.

As the most important results of such training as would be given in well-conducted school gardens, on the mind and general life of the child, the following may be mentioned:—

(1) To develop the powers of observation by studying the manner of growth of plants and the effect which different methods of treatment will produce in their development. Such powers of observation will be of considerable advantage. New

interests will be created in the common things of life, which without such training would remain unknown and unappreciated.

(2) In a school garden, the necessary work of laying out of beds, and of the correct manipulation of the tape line cannot be too highly estimated as a valuable addition to education. The power to lay off a straight line, and work to that line, is, as most employers of adult labour know, a power that is largely absent from the working population, especially in the country districts. This glaring defect will be most certainly corrected in such training as should be received in connexion with school gardens efficiently directed.

(3) The faculty of observation, on which the reflective powers must work in the general development of mind and morals, the effort to draw out that observation and to strengthen it by daily use in the many directions which a school garden supplies, cannot fail to tell very powerfully on the general mental and moral natures, and in the upbuilding of good useful characters. Indifference to our general surroundings is the fatal cause of narrow knowledge and consequently limited development.

(4) In all countries where enforced labour in any direction has for a long period existed, as soil cultivation did in this for the many years of slavery, the emancipated and their descendants have generally manifested an aversion to that description of labour. School gardens should be effective in correcting this feeling, for the children will be at first interested in, then will get to love, nature as she manifests herself in her varied forms in plant life. In the course of a few years, instead of the aloofness from agriculture which we now witness in so large a number of our young and intelligent people, leading them to seek residence in the cities and towns, and to search for employment in directions already overcrowded, we shall find an eagerness to follow a pursuit which is more fruitful than most others of real pleasure, and which, if patiently and perseveringly followed, will not fail to yield a fair profit.

(5) The efforts of the Agricultural Society to stimulate improvements in the cottages of the peasantry and their general surroundings have effected very satisfactory results in certain localities, and no doubt a continuation of effort will secure additional progress; but a large majority of our adult population has acquired a spirit of apparent perfect content with their untidy environments, and it is to be feared that the rising generation must be looked to for any large and general advances in neat cottages, with their well-kept kitchen gardens and flowering plots. It will be almost impossible, if the children are handled, and their love of nature is excited, and their enthusiasm cooled in the school gardens, for improved tasks and industrial habits not to be carried to their homes; and, in time, it might reasonably be expected that instead of cottages in the midst of bush, or with economic plants stuck anywhere, and anyhow, homesteads will be marked with evidences of intelligent industry, care, and comfort.

If this expression to our agricultural education could be secured, it is more than probable that within the next twenty years there will result a more intelligently industrious population, reaping advantages from their husbandry. On every hand in our country districts, neat cottages with their nicely kept gardens, the people generally contented, happy, and prosperous, would be noticeable, and the Government would derive an increase of revenue from enlarged production, that should enable it to undertake and carry through public improvements.

AGRICULTURAL INSTRUCTORS AND THEIR WORK.

BY J. THOMAS PALACHE, Jamaica.

Amongst the several measures recently adopted in Jamaica for the agricultural progress of the country and its people, there is none giving greater benefit than that of the appointment of Agricultural Instructors, whose duty is to go amongst the peasant proprietors and, by lectures, instruction, and practical demonstrations instruct them in improved methods of tilling, manuring, planting, and pruning the different crops that our varied soil and climate allow them to cultivate.

Many people are of opinion that the only means of improving the agricultural knowledge of the country is to establish agricultural colleges where agriculture in all its branches could scientifically be taught. Without questioning the usefulness of these colleges for the rising generation, it is important that the thousands of elderly peasant proprietors, themselves the heads of families, who whilst owning and cultivating land to the best of their ability are still ignorant of the most improved methods of tillage and manuring, which scientific research has discovered, the practical application of which would be of such great use to them in increasing their crops and improving their holdings, should be agriculturally educated. I would suggest to those advocates of agricultural colleges to ask themselves what would have to be the size of these colleges? What the cost to provide this scientific and agricultural education for these thousands? The Agricultural Instructors are inexpensively, yet surely, carrying into the homes of the peasant proprietors the practical results of scientific knowledge, and are quietly helping on the agricultural progress of the country.

The idea was first suggested by our present Director of Public Gardens and Plantations during the Governorship of Sir Henry Blake, and at present, there are five Instructors engaged in the work. The island has been divided into five districts: (1) Westmoreland, Hanover, and part of St. James, containing 468 square miles and 9,121 small holdings; (2) St. Elizabeth, Manchester, and that part of Clarendon south of Chapelton, 1,048 square miles with 27,663 holdings; (3) St. Catherine, St. Mary, and Portland, 922 square miles with 24,532 holdings; (4) St. Andrew, and St. Thomas, 530 square miles, 10,379 holdings, and (5) Part of St. James, Trelawney, St. Ann, upper Clarendon, 1,055 square-miles with 2,645 holdings.

At first, the work of the Instructors was most onerous and difficult, owing to the fact that the people were very suspicious. It required the greatest tact and persuasion to induce them to listen to or to permit of any instruction in their places, they alleging that the Instructors were being sent by the Government to find out what they possessed, so as to tax them. This prejudice, I am glad to say, is fast dying out.

The next difficulty encountered was the not unnatural belief of men, who had all their lives been cultivating the soil, and had come to think that they knew all that there was to be known, that they did not require any further instruction. This idea is also steadily fading away, and the demands on the time of the Instructors can hardly be met.

The steps taken by the Government to popularize agricultural teaching amongst the elementary teachers, by the annual courses of instruction at the Mico College and at Hope Gardens have been of the greatest service to the Instructors, as the teachers now gladly help to organize meetings, and place their schoolhouses at their disposal for lectures. The work of the Instructors consists principally in aiding in the organizing of branch agricultural societies, attending the meetings of such societies, delivering addresses and lectures; attending the places of the peasant proprietors and the large proprietors if desired, giving actual and practical instruction in tillage, application of manures, planting, pruning, and generally advising in all agricultural subjects; advising and instructing on school gardens; endeavouring to induce the planting of new varieties and new products in districts that appear suitable; giving advice on the keeping, breeding, and rearing of domestic animals.

I may here mention one instance of the useful result of this work. Some years ago it was found that sarsaparilla did not form one of the products cultivated in the Manchester district. Plants were obtained from the Director of Public Gardens and Plantations and distributed amongst a few people, who promised to care them and in turn distribute the seedlings amongst their neighbours. The plant has now spread all over Manchester, and one dealer assured me that from January to September he purchased over £1,000 worth for shipment abroad.

Improved cultivation of this valuable plant, and a selection of suitable varieties are now being undertaken, and one of the

Inspectors of Schools has kindly placed a piece of ground at Hartham in Manchester, where he is planting sarsaparilla, to be used as a plot for instruction, and for actual demonstrations in the cultivation of this serviceable product.

The work of the Instructors is most arduous, owing to the hilly nature of the country to be traversed. It requires to be continuous and to be followed up by visit after visit so as to drive home any good results obtained.

The foregoing is a short sketch of the work of the Agricultural Instructors of Jamaica, which is slowly and gradually, but nevertheless surely, revolutionizing the agricultural methods of the peasant proprietor of Jamaica by helping him to improve his holding and the quality of his produce.

WEST INDIAN AGRICULTURAL CONFERENCE, 1908.

The representatives from British Guiana, the Leeward and Windward Islands arrived at Bridgetown, Barbados, on Tuesday, January 14, 1908, in the Royal Mail Steamships in time to attend the seventh West Indian Agricultural Conference arranged for that date. Those from Trinidad and Jamaica did not arrive until later in the afternoon. They were met on arrival by the members of the Reception Committee and by officers of the Imperial Department of Agriculture for the West Indies.

The Conference was opened at 4 p.m. on Tuesday, January 14, in the Assembly Rooms of the Barbados Mutual Life Assurance Society, Bridgetown, under the presidency of Sir Daniel Morris, K.C.M.G., Imperial Commissioner of Agriculture for the West Indies, by his Excellency the Governor of Barbados (Sir Gilbert T. Carter, R.N., K.C.M.G.). The opening ceremony was attended by all the representatives from the several West India Islands, except those from Trinidad and Jamaica, the representatives for the Canadian Reciprocity Conference, the Hon. D. T. Tudor, the Colonial Secretary of Barbados (Lord Basil Blackwood), and a large number of the principal officials, merchants, and planters of the island.

The following is the list of representatives appointed from the several West Indian Colonies to attend the Conference :—

JAMAICA.

The Representative of the Board of Agriculture :—

The Director of Public Gardens and Plantations (The Hon W. FAWCETT, B.Sc., F.L.S.).

The Representative of the Jamaica Agricultural Society :—
J. R. WILLIAMS, ESQ., M.A.

BRITISH GUIANA.

The Representatives of the Board of Agriculture :—

The Director of Science and Agriculture and Government Analyst (Professor J. B. HARRISON, C.M.G., M.A., F.I.C., F.C.S., F.G.S.), (Chairman).

The Hon. B. HOWELL JONES.

The Representative of the Royal Agricultural and Commercial Society :—

The Hon. B. HOWELL JONES.

The Principal, Queen's College (T. A. POPE, ESQ., B.A.).

TRINIDAD AND TOBAGO.

The Representative of the Trinidad Agricultural Society :—

A. F. CLARK, ESQ.

The Government Analyst and Professor of Chemistry (Professor P. CARMODY, F.I.C., F.C.S.).

The Superintendent of the Royal Botanic Gardens (J. H. HART, ESQ., F.L.S.).

The Inspector of Schools (J. H. COLLENS, ESQ., V.D.).

WINDWARD ISLANDS.

The Representative of the Windward Islands (The Hon. EDWARD DRAYTON, C.M.G., Colonial Secretary).

The Representatives of the Grenada Agricultural & Commercial Society :—

The Hon. W. GRAHAME LANG.

F. RAMSAY HARFORD, ESQ.

The Agricultural Superintendent, Grenada (R. D. ANSTEAD, ESQ., B.A.).

The Representative of the St. Vincent Agricultural & Commercial Society :—

The Hon. J. G. W. HAZELL.

The Agricultural Superintendent, St. Vincent (W. N. SANDS, ESQ.).

The Representative of the St. Lucia Agricultural Society :—

The Hon. E. G. BENNETT.

The Inspector of Schools (C. F. CONDELL, ESQ.).

The Agricultural Superintendent, St. Lucia (J. C. MOORE, ESQ.).

LEEWARD ISLANDS.

The Representative of the Colony of the Leeward Islands (The Hon. E. ST. JOHN BRANCH, Colonial Secretary).

The Government Analytical and Agricultural Chemist & Superintendent of Agriculture (The Hon. FRANCIS WATTS, C.M.G., D.SC., F.I.C., F.C.S.).

The Representative of the Antigua Agricultural and Commercial Society:—
A. P. COWLEY, ESQ.

The Agricultural and Science Master, Antigua (A. H. KIRBY, ESQ., B.A.).

The Curator, Botanic Station, Dominica (JOSEPH JONES, ESQ.).

The Representative of the Dominica Agricultural Society:—
A. R. C. LOCKHART, ESQ.

The Representatives of the Dominica Planters' Association:—
ED. A. AGAR, ESQ.
L. LAMBERT BELL, ESQ.

The Agricultural Representative of the Presidency of Montserrat:—
The Revd. C. W. JOHNSON.

The Curator, Botanic Station, Montserrat (WILLIAM ROBSON, ESQ.).

The Agricultural Superintendent, St. Kitt's (F. R. SHEPHERD, ESQ.).

The Representative of the St. Kitt's Agricultural & Commercial Society:—
A. D. C. ADAMSON, ESQ.

BARBADOS.

The President of the Education Board:—
His Lordship the Bishop of Barbados (The Right Revd. W. P. SWABY, D.D.).

The Head-master of Harrison College (The Revd. H. A. DALTON, D.D.).

The Island Professor of Chemistry in Chemical charge of Sugar-cane Experiments (Professor J. P. d'ALBUQUERQUE, M.A., F.I.C., F.C.S.).

The Agricultural Superintendent, Barbados (J. R. BOVELL, ESQ., F.L.S., F.C.S.).

The Lecturer in Agricultural Science (LONGFIELD SMITH, ESQ., B.Sc., Ph.D.).

The Inspector of Schools (The Revd. Canon REECE).

The Representatives of the Barbados Agricultural Society:—
The Hon. F. J. CLARKE, C.M.G., M.A., M.C.P., (President).
The Hon. FORSTER M. ALLEYNE, M.A., M.L.C., and
The Hon. G. LAURIE PILE, M.L.C., (Vice-Presidents).
G. ELLIOTT SEALY, ESQ., M.C.P.
T. W. B. O'NEAL, ESQ., B.A., M.C.P.

OFFICERS OF THE IMPERIAL DEPARTMENT OF AGRICULTURE FOR THE WEST INDIES.

The Imperial Commissioner of Agriculture for the West Indies (The Hon. SIR DANIEL MORRIS, K.C.M.G., M.A., D.SC., D.C.L., F.L.S.).

Scientific Assistant (WALTER BIFFEN, ESQ., B.SC.).

Entomologist (HENRY A. BALLOU, ESQ., M.SC.).

Mycologist and Agricultural Lecturer (F. A. STOCKDALE, ESQ., B.A., F.L.S.).

Travelling Inspector in connexion with Cotton Investigations (THOMAS THORNTON, ESQ., A.R.C.S.).

HONORARY MEMBER.

The Government Entomologist, New South Wales Department of Agriculture (WALTER W. FROGGATT, ESQ., F.L.S.).

The Agricultural Society of Barbados and the Chamber of Commerce appointed a Reception Committee in connexion with the Agricultural Conference, and the Canadian Reciprocity Conference held in the island at the same time, as follows:—

The Hon. F. J. CLARKE. C.M.G., M.A., M.C.P., (Chairman); the Hon. FORSTER M. ALLEYNE, M.A., M.L.C.; the Hon. G. L. PILE, M.L.C.; the Hon. LORD BASIL BLACKWOOD, M.L.C., (Colonial Secretary); the Hon G. A. Goodman, K.C., M.C.P.; the Hon. J. CHALLENOR LYNCH, M.L.C.; J. R. BOVELL, ESQ., F.L.S., F.C.S.; Professor J. P. D'ALBUQUERQUE, M.A., F.I.C., F.C.S.; G. ELLIOTT SEALY, ESQ., M.C.P.; T. W. B. O'NEAL, ESQ., M.C.P.; G. SEBERT EVELYN, ESQ.; C. E. GOODING, ESQ. M.D., M.C.P.; V. HÄNSCHELL, ESQ.; E. I. BAEZA, ESQ.; J. R. BANCROFT, ESQ.; H. B. G. AUSTIN, ESQ.; T. W. WILKINSON, ESQ.; and F. A. STOCKDALE, ESQ., B.A., F.L.S., and A. G. HOWELL, ESQ. (Honorary Secretaries to the West Indian Agricultural Conference); W. H. ALLDER, ESQ. (Secretary to the Canadian Reciprocity Conference); and J. S. DASH, ESQ. (Hon. Secretary).

Honorary Secretaries to the Conference	F. A. STOCKDALE, ESQ., B.A., F.L.S and ALLEYNE GRAHAM HOWELL, ESQ.

The Reception Committee very kindly made arrangements for excursions to the Bulkeley and Carrington Sugar Factories, to Bathsheba and The Crane, and to the Barbados Cotton Factory on January 16, 17, and 19.

The following programme of proceedings was arranged for the Conference :—

Tuesday, January 14.—Opening of Conference, 4 p.m.

Wednesday, January 15.—Meeting of Conference, 11 a.m. to 1·30 p.m. and from 2·30 p.m. to 3·45 p.m.
Reception at Government House.

Thursday, January 16.—Excursion to Bathsheba and country districts.

Friday, January 17.—Meeting of Conference, 10 a.m. to 1·30 p.m. and from 2·30 p.m. to 3·30 p.m.
Visit to Cotton Factory, 3·30 p.m. to 4 p.m.
Reception at Chelston.

Saturday, January 18.—Meeting of Conference, 10·30 a.m. to 1 p.m.
Conference Dinner.

Sunday, January 19.—Excursion to The Crane and country districts.

Monday, January 20.—Meeting of Conference, 10 a.m. to 1·30 p.m., and from 2.30 to 3.30 p.m.

The Conference was opened at 4 p.m. on Tuesday, January 14, and a large gathering of the ladies, planters, officials, and merchants of the island was assembled.

Among those present at the opening ceremony were his Excellency the Governor, SIR GILBERT T. CARTER, R.N., K.C.M.G., accompanied by LADY CARTER, Mrs. PARKER and Mr. OTHO CARTER, (A.D.C. and Private Secretary); LADY MORRIS; Hon. W. P. LEACOCK, President of the Legislative Council, and Mrs. LEACOCK; Mrs. F. J. Clarke; Mrs. EDWARD DRAYTON; Miss HOWELL JONES; Miss HARRISON; Mr. C. P. CLARKE, Solicitor General; Mrs. S. S. ROBINSON; Mr. H. E. THORNE, M.C.P.; the Hon. LT.-COL. and Mrs. KAYE; the representatives appointed to attend the Canadian Reciprocity Conference (with the exception of those from Trinidad and Jamaica) as follows: E. A. SAVAGE, ESQ., and J. R. WILLIAMS, ESQ., M.A. (Jamaica); D. G. GARRAWAY, ESQ., and C. G. A. WYATT, ESQ., (British Guiana); the Hon. R. H. MCCARTHY, C.M.G., and EDGAR TRIPP, ESQ., (Trinidad); the Hon. EDWARD DRAYTON, C.M.G., (Grenada); FRANK W. GRIFFITH, ESQ., (St. Vincent); the Hon. H. A. SMALLWOOD, (St. Lucia); the Hon. E. ST. JOHN BRANCH, his Honour T. L. ROXBURGH, the Hon. S. L. HORSFORD, his Honour W. DOUGLAS YOUNG, C.M.G., (Leeward Islands); the Hon. E. T. GRANNUM, M.L.C., V. HÄNSCHELL, ESQ., E. I. BAEZA, ESQ., DARNLEY C. DA COSTA, ESQ., J. ALLAN JONES, ESQ., the Hon. G. A. GOODMAN, K.C., M.C.P., the Hon. J. CHALLENOR LYNCH, M.L.C., S. S. ROBINSON, ESQ., M.C.P., ALISTAIR CAMERON, ESQ., and E. W. MAHON, ESQ., (Barbados).

His Excellency the Governor, on rising to welcome the delegates, opened the proceedings of the Conference with the following speech :—

Ladies and Gentlemen, I am here this afternoon to perform a very pleasant task. It is to bid the representatives of both the Conferences present at this meeting a hearty welcome to Barbados, not only in my own name by virtue of the office I hold in this ancient and very interesting colony, but in the name of the whole people.

There is, however, what I might with propriety call an official side to this gathering, which has reference to the West Indian Agricultural Conference, now here for the purpose of holding its seventh annual meeting, whose President, Sir Daniel Morris, will shortly deliver his opening address. I note that Sir Daniel Morris with his usual care and thoroughness has arranged a programme which ought to satisfy the most exacting agriculturist and should yield a mine of information to those whose interests lie in the direction of scientific agriculture.

I am quite sure that the Governments of the various colonies in this part of the world, as well as the planters, no matter what their special interests might be, thoroughly realize the great educational value of these meetings, and appreciate the efforts which are being made, under the auspices of the Imperial Department of Agriculture, to enable these colonies, especially the sugar-producing ones, to compete on more equal terms with science, in combination with capital, in Europe and America.

I am not sure, however, that while recognizing to the full the value of the services given, we are not sometimes apt to overlook the virtues of the Imperial Government which gave us the Department of Agriculture, and placed at its head the gentleman who has been such a conspicuous success in the position he occupies. We must not forget, too, the generous assistance given to the West Indies by the British Cotton-growing Association, and the practical interest shown by Sir Alfred Jones by bringing out a number of gentlemen in January 1907, associated with cotton culture, with a view to the extension of this industry in the West Indies.

It is not my province to anticipate matters which will be dealt with by Sir Daniel Morris, but I may say that Barbados, at least, has profited largely by this supplemental industry, and there is reasonable hope that the growth of cotton will well repay the careful cultivator. Lest it may be thought that I desire to pose as an instructor rather than as a pupil, I will only add that, in return for your valuable aid, Barbados will, I am sure, do all in its power to make your stay agreeable to you, and I trust we may help you to take away a favourable impression both of the island and of its people. (Prolonged Cheers.)

I will now ask Sir Daniel Morris to deliver his address. (Applause.)

PRESIDENTIAL ADDRESS.

SIR DANIEL MORRIS then addressed the Conference:—

This is the Seventh Conference assembled for the consideration of means for advancing the material prosperity of these colonies. I join in the welcome just offered by His Majesty's Representative in this colony and I trust that as a result of this Conference still greater progress will be made in all departments of agricultural activity.

We have present a larger number of representatives than on any previous occasion; men who possess a direct interest in the welfare of these colonies, and who are in a position to speak with authority in regard to the many questions to be submitted for consideration. A glance at the programme of proceedings will show the variety of subjects to be dealt with. From the experience of past years, I am able to look forward with confidence to your hearty support in initiating discussion and contributing information of a valuable character based on knowledge and experience gained under the varying conditions existing in the West Indies.

The subjects to be dealt with lie at the foundation of the material prosperity of these colonies, and the measure of success that has already attended our efforts should be an encouragement for us to persevere on the lines hitherto followed.

As at former Conferences, it is proposed to give a prominent position to proposals for introducing the teaching of agriculture into the primary and secondary schools in the West Indies. Progress in this direction has necessarily been gradual, but, on the whole, we are justified in looking for ultimate success.

SUGAR INDUSTRY.

The prospects of the Sugar Industry, from an agricultural point of view, are not unpromising. Owing to the prevalence of drought, the sugar crop at British Guiana is estimated at from 16 to 20 per cent. below the average. At Trinidad, the prospects of the crop are regarded as favourable. At Barbados, a moderate crop is anticipated, as also at Antigua and St. Kitt's.

The quantity of sugar exported from the West Indies and British Guiana in 1906 was 254,118 tons, of the value of £2,157,147. Taking also the value of the molasses and rum, the total value of the exports of cane products was £2,626,914. The following are the quantities (in tons) of sugar exported from each colony, viz: British Guiana, 114,951; Barbados, 50,630; Trinidad, 45,004; Leeward Islands, 24,000; Jamaica, 11,934; Windward Islands, 6,028.

It will be observed that British Guiana supplies about 45 per cent. of the total exports of sugar from these Colonies. At Jamaica, the average value of the exports of sugar and rum during the last five years is £245,170.

It will be admitted that, in spite of the many discouraging circumstances that have operated against the success of the sugar industry, it still remains the chief mainstay of the prosperity of British Guiana, Barbados, Antigua, and St. Kitt's. Its failure would also largely affect the prosperity of Trinidad and Jamaica.

The chief concern at the present moment is in regard to finding a reliable market for sugar products. During the last three or four years, the Dominion of Canada, by means of the preference offered to Great Britain and her colonies, has afforded a favourable market for West Indian sugar and molasses. It is estimated that about 79 per cent. of the total sugar consumed in Canada, for the year ended June 30 last, was received direct from the West Indies. The following, taken from Canadian returns, illustrates the value of the sugar and molasses imported into Canada, during the years mentioned, from the British West Indies and British Guiana:—

Articles.	1902.		1904.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.	£	Tons.	£	Tons.	£
Sugar ..	21,467	183,899	139,830	1,067,149	162,346	1,416,965
	Gallons.		Gallons.		Gallons.	
Molasses and Syrups	2,696,601	95,731	2,554,291	113,844	4,141,177	155,901
TOTAL VALUES.		279,630		1,180,993		1,572,866

The results of the experiments that have been carried on in the principal sugar colonies in raising varieties of seedling canes less susceptible to disease, and yielding a larger amount of sugar, are proving of increased value. Larger areas are being planted year by year with seedling canes, and the more enterprising members of the planting community are convinced that seedling canes, selected with due regard to local circumstances, are proving more remunerative than the old varieties.

The work in this direction, it is admitted, is only in the initial stages. There are still more promising seedling canes under experimental trial, and it is not improbable that in the near future, seedling canes capable of resisting disease, while, at the same time, yielding high percentages of sugar, will be generally cultivated in these colonies.

As some indication of the value attached in other countries, to seedling canes raised in the West Indies, I would mention the

Demerara canes D. 74 and D. 95, which are being widely cultivated in Louisiana and regarded as superior to any of the canes hitherto in cultivation in that part of the world.

According to the report on the Louisiana Agricultural Experiment Station for 1906, seedling canes D. 74 and D. 95 have again maintained their superiority over the home canes, not only at the Stations but throughout the State, the result being, a large extension of the area being planted in this cane this year. This applies particularly to cane D. 74, which is highly commended by practically all planters.

In British Guiana, reports issued by Professor Harrison show that the total area under cultivation with varieties of sugar-cane other than Bourbon is about 30,000 acres, as compared with 15,000 acres in 1905-6, and 10,000 acres in 1903-4.

'The most notable increases of area under individual canes are those of D. 625, from 3,357 to 6,600 acres, and of B. 208 from 3,125 to 4,687 acres, or about 100 per cent. and 50 per cent. respectively. The seedlings D. 145 and the two above-mentioned have, during the season, maintained their superiority to the Bourbon as sugar producers.'

In a recent report, Professor Harrison states: 'There can be no doubt that it is advisable for cane farmers on the coast lands to plant either D. 109, D. 145, D. 625, or B. 147 in place of the Bourbon; whereas farmers on the lighter loamy lands should try D. 145 or B. 208.'

The records obtained and published by the Board of Agriculture show that during the last five years new varieties of sugar-cane had given, over large areas, mean results of 8, 10, 22, and 35 per cent. higher than the mean returns from the Bourbon cane.

The Sugar-cane Experiments Committee of the Board of Agriculture adds: 'It must be borne in mind that, in the case of many of the experiments, the varieties of seedling canes have been grown on land on which the latter cane does not flourish, while the Bourbon returns are, as a rule, from lands of average quality.'

In addition I would mention that on one estate in Demerara, with 4,404 acres under seedling canes and 1,570 acres under Bourbon canes, the seedling canes, taken together, averaged 26 per cent. better than Bourbon for the crop of 1907. Amongst the seedling varieties, 2,403 acres were under B. 208, and this variety, during the crop of 1907, yielded 40 per cent. more sugar than the Bourbon cane.

In the paper read by Mr. Bovell at the Jamaica Conference (*West Indian Bulletin*, Vol. VIII, p. 78), it was stated that more profit was derived from the cultivation of the Barbados and British Guiana seedling canes, grown on the above estate during the six years 1901-6, than would cover the cost of the sugar-cane experiments at Barbados since they were inaugurated in 1884.

At Barbados itself, on some few estates, no other canes are planted except seedlings. On others, appreciable portions are planted with seedlings of various varieties.

In one instance, recorded by Mr. Laurie Pile at a meeting of the Agricultural Society at Barbados in December 1906, in reference to cane B. 376, 58 acres gave an average yield of 29½ tons of cane per acre, and the average yield in commercial sugar was at the rate of 2·95 tons per acre. Another instance is referred to by Mr. Bovell (*West Indian Bulletin*, Vol. VIII, p. 76) as follows :—

'The owner of Carrington plantation was good enough to give me the average returns obtained on that estate from the White Transparent and B. 147 for the past four years, i.e. 1903-6 inclusive. For that period there were practically about 200 acres of plants and ratoons of each variety grown each year. During that time, the B. 147 gave, on the average, 398 lb. of sugar more per acre than the White Transparent. This would, in round numbers, amount to about 160 short tons of sugar for the four years. At £9 per ton for the sugar and its molasses, the gross value would be £1,440. Assuming that the cost of manufacture amounted to £200, there would remain £1,200 as the profit to the estate for the four years due to cane B. 147 being grown in preference to White Transparent.'

In a report presented by the Committee of the Barbados Agricultural Society, it is stated that 'the Sugar Experiments carried on at Barbados during the last few years have been of great advantage to the cause of agriculture in the colony, and it would be a great blow to the sugar industry if they should be obliged to be discontinued, as there is every reasonable hope that even better results may be arrived at in the near future. These experiments cannot be carried on in their fullness without the help of the Imperial Department of Agriculture, which has extended them to an enormous degree and with a success which has been a benefit, not only to this island, but to the whole sugar world.'

In the Leeward Islands, the situation in regard to seedling canes is briefly summarized as follows :—

At Antigua, up to about the year 1896, the Bourbon cane was practically the only variety under cultivation. This was so severely attacked by disease that the sugar crop was suddenly reduced to one-half the average production.

The first introduction to replace the Bourbon cane was the White Transparent. For the crop of 1908, returns from seventy-four estates, or practically the whole of the sugar crop of Antigua, show that out of 9,811 acres under canes, 2,578 acres, or 26 per cent., were occupied by improved varieties other than White Transparent. The Bourbon cane occupied only 190 acres.

Returns from St. Kitt's for the crop of 1908 show that on forty-three estates, or practically the whole of the sugar area, 5,314 acres out of a total of 7,500 acres, or 71 per cent. of the canes under cultivation, were newer varieties, i.e., introduced since 1896.

Dr. Watts explains that this large proportion of new varieties in St. Kitt's is due to the fact that the White Transparent, brought from Jamaica, to replace the Bourbon cane,

was not found to exhibit in St. Kitt's that immunity from disease that it had shown elsewhere, and a more resistant cane was consequently looked for. This was found in B. 147—a cane, raised by Mr. Bovell, that was first brought to the notice of West Indian cane planters in 1899, through the agency of the then newly constituted Imperial Department of Agriculture.

Dr. Watts adds: 'If we take the exports of sugar from Antigua and St. Kitt's at, very approximately, 25,000 tons, worth £200,000, and assume that the industry has only been benefited to the extent of 10 per cent. (an amount which will seem moderate to those who experienced the ravages of disease), this would give the very rough approximation of £20,000 a year as the value of the introduction of new varieties of canes—a sum in excess of that spent in maintaining the Imperial Department of Agriculture in its entirety. It is right and desirable that computations of this kind, even though of the rough character here given, should be made in order to bring home to those interested the magnitude of the interests involved.'

A summary of the results obtained in connexion with the working of the central factory scheme at Antigua during the last three years will be presented by Dr. Watts. One striking feature is that out of 6,000 tons of crystals shipped from the island, nearly 2,500 tons represent the gain due to improved methods of crushing and manufacture of crystals. At Barbados, the central factory idea is beginning to take root. Two estates are being fitted with improved machinery with this object in view.

THE CACAO INDUSTRY.

The Cacao Industry of the West Indies ranks second in importance to that of sugar, the exports in 1905-6 being valued at about one and a half million sterling. Cacao forms practically the sole crop of Grenada, and in Trinidad it is worth about double the value of sugar. It is also an important industry in Jamaica, St. Lucia, and Dominica, while at St. Vincent it is one of the crops that have received special attention in connexion with the Land Settlement Scheme.

From figures furnished by the Collector of Customs, Trinidad, it would appear that the average value of local cacao exported from that colony during the last five years was £907,083. Mr. de Gannes has placed a fair production at Trinidad 'at 12 bags of 170 ℔. each to each 1,000 trees planted 12 feet apart,' equal to 616 ℔. per acre. On the other hand, Mr. deVerteuil at the Jamaica Conference placed the average yield per acre at 3½ bags of 140 ℔. each, equal to 455 ℔. per acre.

From the figures published in the 'Handbook of Grenada,' it would appear that the average value of the cacao exported from that colony during the last five years was £236,351. According to Mr. E. M. deFreitas, the average yield in Grenada is about 4 bags of 196 ℔. per acre, equal to 784 ℔. per acre. In both colonies, the cacao crop of 1906 was much below the average, due to severe drought, or possibly, to a combination of drought and the prevalence of disease.

At Jamaica, there is a steady increase in the exports of cacao, as the result of the exertions made by the Botanical Department and the agricultural officers in pushing the cultivation. The total exports for 1905-6 were about 32,587 cwt. of the value of about £105,907. In 1906-7, this had increased to 50,057 cwt. of the value of about £190,216.

At St. Lucia, cacao is being gradually extended. The value of the exports for 1905-6 amounted to £41,520. The value of the exports from Dominica during the same period was £35,185; and from British Guiana, £1,528.

The Imperial Department of Agriculture has paid considerable attention to the cultivation of cacao, and manurial experiment plots have been maintained for several years at Grenada, St. Lucia, and Dominica, and what may be called 'sample plots' have been adopted as centres for affording information to small cultivators in remote districts.

At Grenada, there are two classes of experiments, which may be distinguished, respectively, as 'sample plots' and 'experiment stations.' One series of sample plots has already completed its three-year course and another is now entering on the second year. These are used as demonstration plots by the Agricultural Instructor, and the peasants are thus trained, practically, how to carry out such operations as forking, drainage, and pruning. When a good crop is obtained this serves as an excellent object-lesson to the peasants. As an example, mention may be made of a plot of an area of 1 acre from which last year the owner picked two-thirds of the total crop formerly derived from 5 acres of land.

The experiment stations are established on large estates and consist of not less than 5 acres or 1,000 trees. The cost of the experiments is borne by the owners, the Imperial Department supplying scientific advice and assistance to enable the experiments to be conducted on uniform lines.

In the experiments with cacao carried on at the Botanic Station at Dominica, the most striking and profitable results have been obtained from the use of mulchings of grass and leaves; the gains have been phenominal, and are such as deserve the careful consideration of planters. At Dominica, the Curator has been successful in budding and grafting cacao on a commercial scale. One hundred grafted trees have already been established at the Botanic Station, and it is proposed to establish experiment fields of grafted plants on some of the larger estates in the island.

The working of the cacao plots at St. Lucia is thus described by Mr. George S. Hudson:—

'These plots were each an acre in extent, situated on main roads, and were generally chosen on account of the neglected condition or the unhealthy appearance of the trees. The objects in view were to show that such trees could be restored to health and increased bearing by modern methods of culture, and to demonstrate what operations and what manures were to be depended upon for the improvement. It was hoped that these improved conditions would be noticed,

and would lead peasants and others to adopt such measures as would produce similar beneficial effects on their own property. Eight years ago such operations as manuring, forking, pruning, draining, and clean cultivation were almost unknown in St. Lucia and, in fact, many persons believed some, at least, of these, to be injurious to the cacao. This has been changed as a result of the practical demonstrations furnished by these cacao plots, and on estates and peasant holdings enormously increased returns have been obtained by these means.'

Mr. Moore, the Agricultural Superintendent, adds as follows :—

'The yield of cacao in St. Lucia from an estimated area of 6,200 acres, now yielding, on an average, about 300 lb. of cured produce per acre, could be trebled by means of high cultivation costing, on an average, from £5 to £6 per acre per annum. This means that from the present acreage the exports could in four or five years' time, be raised from 9,500 bags (1905-6 crop), worth (at *6d.* per lb.) £47,500, to 28,500 bags, worth £142,500. In addition, the intrinsic value of the cacao properties would be greatly enhanced.'

FRUIT INDUSTRY.

The exports of fruit (chiefly bananas) from Jamaica are steadily increasing. The demand for fresh tropical fruits in the European markets would fully justify greater attention being paid to the development of the fruit industries of the West Indies. The value of the fruit exported from Jamaica during 1906-7 amounted to £964,781. The only other colony where fruit in any appreciable quantity is shipped is Trinidad. The value of the exports in 1906-7 was £4,682.

The very promising banana industry started a few years ago at Barbados has almost disappeared, owing to the absence of suitable shipping facilities. A few bananas are still being exported. The value in 1906-7 was £718. It should be borne in mind that at almost any time a banana industry on a moderately large scale could be established at Barbados. Mr. Bovell is of opinion that at least 5,000 acres of rich lands, capable of producing bananas at the rate of 600 bunches per annum, exist in this island. The value of these, if sold at a net profit of 1s. per bunch in England, would be £150,000. It would be well, therefore, for planters in Barbados to bear in mind, that in addition to sugar and cotton, they have a third string to their bow in bananas, provided they can obtain suitable shipping facilities. Barbados bananas have a delicate flavour, and, in the English market, they are preferred to any other.

Both Dominica and Grenada have, from time to time, arranged with the West India Committee for excellent exhibits of their fruit at the Shows of the Royal Horticultural Society in London. In these islands also, as well as at St. Lucia, fruit industries of considerable value are capable of being established. The value of fresh fruit (exclusive of limes), shipped from Dominica in 1906 was £838. The exports of fruit from St. Lucia and Grenada were of the respective values of £554 and £266. There is a steady increase taking place in the planting of

budded oranges and grape-fruit, and of the best grafted mangos in all parts of the West Indies. Improved varieties of pine-apples are being cultivated at Jamaica, Dominica, Grenada, and St. Lucia. The delicious mangosteen is regularly produced at Trinidad, Jamaica, and Dominica.

COTTON INDUSTRY.

The total area now under cultivation in cotton in the West Indies is over 24,000 acres. Of this, about 4,000 acres are under cultivation in what is known as 'Marie Galante' cotton at Carriacou and the St. Vincent Grenadines. The steady increase (in acres) that has taken place in the areas planted during the six years 1903-8 is as follows: 1903, 4,000; 1904, 7,600; 1905, 11,238; 1906, 13,100; 1907, 18,166; 1908, 24,000.

The following statement shows the amount of cotton and the value of lint and seed exported from the West Indian Colonies from January 1, 1902, to September 30, 1907:—

Year.	Weight in pounds.	Estimated value of lint. £	Estimated value of lint and seed. £
1902	328,530	7.366	9,676
1903	397,541	9,031	11,878
1904	698,981	26,930	31,891
1905	1,122,800	47,846	63,290
1906	1,577,431	69,092	90,274
9 months ended September 30, 1907	2,013,698	172,204	186,510
TOTAL ...	6,138,981	332,469	393,514

A prominent feature of the season 1906-7 was the high prices obtained for the West Indian produce, owing to the falling off in supplies from the Sea Islands of South Carolina. The highest prices, viz., 2*s.* 8*d.* (64 c.) per lb. was obtained by the island of St. Vincent, an island that is evidently well suited for the production of the finer staples. The largest production in any single island was 852,408 lb. of lint, of the value of £72,326, shipped from Barbados. The estimated value of the lint and seed exported from the West Indies for the nine months ended September 30, 1907, was £186,510. For the six years 1902-7, the total amount of the lint shipped was 6,138,981 lb., while the estimated value of both lint and seed

reached £393,514. We may now regard the Sea Island cotton industry as well established in the West Indies. It is proving a valuable adjunct to the sugar industry, as the operations conveniently fall into line with the routine work of the sugar estates.

In islands like St. Vincent, Montserrat, Nevis, and Tortola where sugar has practically disappeared, the cotton industry has been the means of bringing to them a return of comparative prosperity, and all classes, including the officers in administrative charge of their Government, are fully sensible of the altered conditions. Further, it may be mentioned that the picking of cotton gives light employment at remunerative rates to elderly men, women, and children, who have hitherto found it difficult to obtain the means of existence.

The British Cotton-growing Association continues to afford valuable assistance in connexion with the cotton industry.

The ginning factories now existing are fully able to deal with crops in each island. In many cases the factories are owned by private persons. At Barbados and Antigua, the central factories are worked on co-operative lines. The net profits earned by the Barbados factory during the last season enabled it to pay 12 per cent. on the capital invested.

At St. Vincent, the central factory, in deference to the wish of the cotton growers is still being worked under the control of the Imperial Department of Agriculture.

From the 20,000 acres now under cultivation in Sea Island cotton, it is not improbable that, with an average yield of 150 lb. of lint per acre and an average value of 1*s.* 4*d.* per lb., the total value of the lint and seed will amount to about a quarter of a million sterling. In another five years, it would be safe to assume that the total value of the cotton industry to the West Indies will not fall far short of half a million sterling.

In reviewing the very promising position of the cotton industry in the West Indies in a letter addressed to the Colonial Office, dated August 12 last, I stated as follows: 'While I rejoice to be in a position to report that a new industry of considerable value has become established during the last six years in the West Indies, it is incumbent upon me to place on record that the cotton industry, even when developed on a larger scale, cannot entirely take the place of the sugar industry, upon which the welfare and prosperity of so many of these colonies have hitherto depended. There is no doubt that in the smaller islands, where the cultivation of sugar has almost disappeared, cotton will continue to prove of great value; but in colonies like British Guiana, which is apparently unsuited to the cultivation of Sea Island cotton, and at Barbados, Antigua, St. Kitt's, and Jamaica, where sugar and cotton can, with advantage, be cultivated on the same land as alternate or rotation crops, the decay of the sugar industry would throw back the general prosperity to such an extent as to counterbalance the good results arising from the development of other industries.'

LIME JUICE INDUSTRY.

Very valuable information in connexion with the Lime Industry in the West Indies was contributed in the papers prepared for the Jamaica Conference. (*West Indian Bulletin* Vol. VIII, pp. 167-72.)

The total value of lime products exported from the island of Dominica during the year 1906 was £55,174. The exports of lime products from Montserrat during the same period were £6,888. The exports from Jamaica were of the value of £3,909, and from Trinidad £982.

A syndicate of British capitalists has obtained a grant of 1,500 acres of land in British Guiana at Agatash on the Essequebo River for the purpose of establishing a lime industry. There is no reason why success should not attend an intelligent effort in this direction, especially as lime trees are known to flourish in various parts of British Guiana.

The need for improvement in the quality of West Indian concentrated lime juice has long been under consideration. As stated by the Hon. J. C. Macintyre, it has been pointed out that the great difference between the price of Sicilian and West Indian concentrated juice, amounting usually to about £3 per hogshead, is very largely due to the indifferent preparation of the latter, as it usually contains large quantities of pulp and foreign matter and carbonized juice, due to excessive concentration.

Mr. Macintrye has demonstrated, that where the juice is allowed sufficient time to settle and properly clear, an increase in price, equal to about 30*s.* per hogshead may be obtained for the concentrated juice. This would be equal to a net gain of 28*s.*, after deducting discount and changes, based on the value of the product.

Citrate of lime is now becoming one of the regular articles of export both from Dominica and Montserrat. It is evident that by preparing concentrated juice of high quality and the manufacture of citrate of lime, the value of the products of the lime industry in the West Indies can be considerably increased.

In order to assist lime planters to obtain reliable data in regard to the advantages likely to arise from the preparation of citrate of lime as against concentrated juice, the Imperial Department of Agriculture communicated with representative firms in Europe and America with the result stated below.

The opinion of one of the largest buyers of citrate of lime in the United States was:—

'Citric acid contained in citrate of lime sells at a higher price than that contained in concentrated juice. We would give preference to citrate as against concentrated juice, and the tendency is strongly set in that direction, and will remain so. We consider the saving in making citrate to be at least 10 per cent.'

A British firm dealing largely in citrate of lime held a similar opinion :—

'Citrate of lime is preferred to concentrated juice by acid makers .... A higher price is paid for citrate of lime than for juice, and there is a considerable saving in freight, casks, and loss by leakage ..... There is no chance whatever of the demand for citrate of lime falling off and returning to concentrated juice. We believe that more citric acid can be saved in making citrate than in making concentrated juice. The demand for citric acid averages about 6,000 tons of citrate per year, of the value of over half a million sterling.'

In a paper prepared by Dr. Watts (*West Indian Bulletin*, Vol. VIII, pp. 167-72) information is given in regard to the construction and equipment of a factory for the manufacture of commercial citrate of lime, with plans for a factory capable of dealing with a crop of about 12,000 barrels of limes, equivalent to about 100 casks of concentrated juice.

A pamphlet entitled 'The A. B. C. of Lime Cultivation,' dealing also with the manufacture of concentrated juice and citrate of lime, is now in preparation by the Imperial Department of Agriculture.

RICE INDUSTRY.

Reference has already been made to the remarkable development of the Rice Industry in British Guiana. The following figures will show the progress in recent years : —

Period.	Rainfall in inches.	Acreage.	Yield.	
			Paddy, tons.	Equal to rice, tons.
1898-9	49·93	6,477	6,374	4,653
1902-3	94·48	16,628	16,522	12,138
1906-7	112·79	26,567	40,472	30,152

From the returns published, it would appear that whilst seven years ago the imports of rice into British Guiana were a little over 25,000,000 lb., last year they had fallen to 6,000,000 lb., showing that during a comparatively short period, the imports had shrunk more than 75 per cent. It is stated that although a considerable revenue may have been lost by the falling away in the imports of rice, this has been practically made up by the larger imports of other commodities. British Guiana is now in a position not only to produce rice to meet its own consumption, but also to export to other West Indian colonies, and to French and Dutch Guiana. The first rice exported from British Guiana amounted to 10,506 lb. in 1902-3. Last year, the exports amounted to 3,474,512 lb. of the value of $89,078 (£18,558).

Rice is also being cultivated to some extent in Trinidad, Jamaica, and St. Lucia, but the exact figures are not available. It is hoped that further information in regard to the rice industry of British Guiana will be presented by the representatives from that colony.

COCOA-NUTS.

The chief areas occupied with cocoa-nut plantations are at Jamaica, Trinidad, and British Guiana. The exports for 1906-7 were as follows:—

Colony.	Quantity.	Value. £
Jamaica	7,092,298	28,369
Trinidad	13,089,937	40,500
British Guiana	49,990	149
TOTAL	20,232,225	69,018

From the fact that high prices have been ruling lately for fresh cocoa-nuts, it would appear that there is a world's shortage in this commodity—probably due to drought and disease. According to information from Jamaica, the exports from April 1, to November 2, 1907, amounted to 8,706,128 nuts. The prices on the spot on November 22 were 115*s.* per thousand.

The area in cocoa-nuts at British Guiana is probably about 7,400 acres. It is pointed out by the Board of Agriculture that 'neglect and over-crowding' are productive of poor returns, as well as the prevalence of disease.

The diseases of cocoa-nuts have been carefully investigated by the Imperial Department of Agriculture and the services of the Mycologist were loaned to Trinidad in order to study the diseases in that colony. Specimens of diseased plants from British Guiana have also been carefully examined. Similar diseases occur also in Jamaica and to a very serious extent in Cuba.

Provided the diseases referred to are kept in check, there would appear to be favourable openings for extending the area under cocoa-nuts in the West Indies and British Guiana. It might be recommended, subject to the conditions existing locally, to plant cocoa-nuts generally in the lowlands and along the banks of rivers in British Guiana. Some districts in Trinidad are evidently well adapted for growing cocoa-nuts, preference being given to areas where disease has not yet shown itself in a virulent form. If high prices continue, this would justify more attention being devoted to cultivation, as well as to the control of diseases.

RUBBER INDUSTRY.

Interesting information in regard to the extension of Rubber cultivation in the West Indies was prepared for the Jamaica Conference (*West Indian Bulletin*, Vol. VIII, pp. 191-204).

At Trinidad, some thirty-three estates are now engaged in the industry, and the total number of trees planted is estimated at 300,000. Rubber is being exported from Trinidad and Tobago in fairly large quantities. In recent account sales, 3*s.* 2*d.* was obtained for scrap and 4*s.* 3*d.* for Castilloa sheet rubber. At Tobago, scrap rubber realized 4*s.* per lb., while prepared sheet rubber obtained from 5*s.* to 5*s.* 3*d.* per lb. A recent shipment from Louis D'Or plantation in Tobago consisted of 1,200 lb. of commercial rubber.

Mr. Hart reports that Castilloa trees have done well in all parts of Trinidad, and appear to suit the conditions of soil and climate. Eight or ten estates are now planting trees of the Para rubber (*Hevea*). The Lagos silk rubber (*Funtumia*) is also being planted at Trinidad. Mr. Hart reports that specimens of rubber taken from *Funtumia* trees six and a half years old were valued in 1903 at 2*d.* to 3*d.* per lb. less than Castilloa. Trinidad exports but little, if any, balata, although the balata tree is indigenous to the colony.

A good deal of attention has been devoted to the development of a rubber industry in British Guiana. Several concessions for land for planting rubber have been applied for. The late Dr. Carl Bovallius was of opinion that along the banks of the Essequebo above Bartica, along the Cuyuni and Mazaruni and in many places on the Upper Demerara River, large plantations of *Hevea brasiliensis* and *Castilloa elastica* could be successfully established. He also recommended the planting of the indigenous species of *Sapium* as 'extremely hardy and quick-growing, and likely to give good returns two or three years earlier than the Castilloas, and three or four years earlier than the Heveas.' A number of rubber trees are under experimental trial at the Onderneeming Farm School. The Combined Court has voted the necessary funds for the upkeep of a Rubber Experimental Station at Isorooroo in the north-west district.

There are about 300 Castilloa rubber trees in the island of St. Lucia ranging from eight to twelve years of age. Also a large number of trees has been lately planted. Some of the older trees have recently been tapped with satisfactory results. In January 1906, rubber from St. Lucia was valued at 5*s.* per lb. in London. On Errard estate, 105 Castilloa trees growing among cacao were tapped by Mr. Hudson in August 1906 and February 1907. About eighty of the trees were thirteen years old and the rest about nine years old. In the first tapping of 105 trees, 39½ lb. of cured rubber were obtained, yielding a gross return of £7 13*s.* 1*d.* In the second tapping of 105 trees in February 1907, the gross yield was £4 1*s.* 5*d.* The average return from the two tappings per tree was at the rate of 9½ oz.

cured rubber, yielding a net profit of $10\frac{1}{2}d.$ per tree, making a total of £4 11*s.* $10\frac{1}{2}d.$ for 105 trees.

At Dominica, Castilloa is also regarded as the best rubber tree for cultivation in that island. The tree grows well and it can be depended upon to yield good rubber in eight or ten years from the time of planting. The Lagos silk rubber tree is attacked by black blight, and in other respects it is not regarded as quite so satisfactory as Castilloa. A few plants of *Hevea* have lately been introduced with the view of testing the suitability of the conditions at Dominica.

TOBACCO INDUSTRY.

Mr. Fawcett was good enough to prepare an interesting account of the Tobacco Industry at Jamaica (*West Indian Bulletin,* Vol. VIII, pp. 209-28). The industry in that island is practically the only successful tobacco industry existing in any of the British West Indian Colonies. This is remarkable, as the headquarters of tobacco growing are in the neighbouring island of Cuba, and it has been shown over and over again, that suitable conditions for growing fine tobacco exist in Trinidad, Barbados, and the Windward and Leeward Islands.

The exports of cigars from Jamaica for the year 1905-6 were 40,325 lb. of the value of £20,312; of tobacco leaf, 6,554 lb. of the value of £246, and of manufactured tobacco, 11,261 lb. of the value of £1,251; the total being £21,809.

Experiments have been carried on at St. Kitt's both with shade-grown and sun-grown tobacco. A plot of $\frac{1}{8}$ acre produced shade-grown tobacco for wrappers weighing 69 lb., i.e., at the rate of 552 lb. per acre. The sun-grown tobacco yielded at the rate of 820 lb. per acre. The crop of the latter was disposed of locally at the rate of 1*s.* 2*d.* to 1*s.* 3*d.* per lb. Mr. Shepherd reports: 'The experiments carried on this year (1906-7) have been successful so far as the yield per acre is concerned, and every precaution has been taken to guard against the defects of last year. With respect to the local market, a ready sale can be had for leaf tobacco at the rate of 4 lb. for $1·00; and as 170 lb. cured tobacco have been obtained from a little over $\frac{1}{5}$ acre of land, equal to 800 lb. per acre, the gross proceeds would be at the rate of about £40 per acre.'

A small proprietor at St. Vincent has for some time produced cigars of fair average quality. These are in use in the island and are well spoken of. Nothing has recently been heard of the tobacco industry in Trinidad.

I recommend those interested in tobacco growing to study carefully Mr. Fawcett's paper above referred to.

It is proposed to appoint a Committee of this Conference to discuss the prospects of tobacco growing and to advise whether the services of an expert from Cuba or Florida would be likely to be of advantage in assisting local officers in overcoming some of the difficulties that hitherto have been met with.

DISTRIBUTION OF ECONOMIC PLANTS.

An important service rendered by the various botanical and experiment stations in the West Indies is in raising and distributing economic plants for the purpose of extending the areas under cultivation in sugar-cane, cacao, limes, coffee, spices, grafted mangos, budded oranges, cocoa-nuts, rubber, and timber trees. They also serve to raise the quality and yield of the crops by introducing new and more productive varieties. An approximate estimate of the quantity of plants distributed during the year 1906-7 is 544,900. These plants are usually distributed at cost price, and thus members of the planting community are placed in an advantageous position in extending the cultivation of the older staples, and in starting new ones. The largest number of plants distributed in any one colony was 189,266 at Jamaica. This was followed by 136,652 at Trinidad, and 83,505 at Dominica.

As showing the enormous scale on which improved sugar-canes are distributed, it is on record that, in one season, 198 mule cart-loads of seedling and other canes from the areas in sugar-cane experiments attached to the Botanic Station at British Guiana were distributed in that colony. At Jamaica, 45,965 cane tops and cuttings were distributed, while at Grenada 4,850 plants of D. 95 were disposed of. At Barbados, the number of cane tops and cuttings supplied to plantations in the island and shipped to the neighbouring colonies has been on a considerable scale.

I believe no greater service could be rendered to the cause of agriculture in these colonies than by the liberal and systematic distribution of improved varieties of canes, fruit trees, and other economic plants. This work has been in active operation for many years, and it deserves to be extended in all possible directions.

ANIMAL INDUSTRIES.

Considerable attention is being devoted to the improvement of horses and cattle, and also of small stock kept by the peasantry. Jamaica may be regarded as the headquarters for horse breeding in the West Indies. The importation of thorough-bred horses from England into Jamaica was begun in 1752, and has been continued to the present time. Thorough-bred is regarded as the best strain suited to Jamaica; heavier and coarser breeds are stated not to have been successful. There are good prospects in Jamaica for breeding polo ponies. Good mules are also raised in the island.

At Trinidad and Tobago, the Government Stock Farms have been maintained for many years. In addition to supplying local requirements, the neighbouring colonies have also been able to obtain good Mysore and other cattle, as well as sheep, pigs, poultry, etc.

The Board of Agriculture at British Guiana since its organization has paid special attention to the introduction of pedigree stock, including stallions, a jack donkey of Spanish breed, Shorthorn bulls, half-bred Guernsey bulls, Holstein cows, Zebu cows, Shropshire rams, Berkshire sows, and poultry.

At the small stock farm attached to the Agricultural School at St. Vincent there is a thorough-bred horse, 'Beau II,' (dark bay, 16 hands), a fine thorough-bred Ayrshire bull, an Aryshire grade cow, and a Barbados cow.

A moderately large stock farm, with a number of useful animals, is attached to the Lunatic Asylum at Barbados. It has lately been decided, on the recommendation of the Agricultural Society, to import a jack donkey.

The Agricultural Society at St. Lucia has done useful work in introducing animals to improve local breeds. The Stock Farm at Skerrett's, Antigua, has now been closed and the animals disposed of.

The future efforts of the Imperial Department of Agriculture are proposed to be confined to offering a bonus in the smaller islands for the introduction of a limited number of pedigree animals under conditions that will ensure that the animals are of a suitable character, and that their services are available to the public generally. A sum of about £200 per annum may be expended in this manner.

It is satisfactory to learn that there have been no recent outbreaks of anthrax or other disease amongst animals during the past year. The efforts of the Imperial Department of Agriculture in dealing with anthrax at St. Vincent are being continued on satisfactory lines. About 3,000 animals have been successfully inoculated and the number of deaths is gradually decreasing. A report prepared by the Government Veterinary Surgeon at St. Vincent has recently been published.

Interesting introductions made by the Imperial Department of Agriculture consist of two Punjab goats, landed at Barbados in June 1906. The survivor of these has proved most useful in improving the local breeds. The progeny are of a most promising character and readily command good prices.

In September 1907, four ram sheep were introduced from West Africa. One of these rams measures 33½ inches at the shoulder and weighs 140 lb. All the animals are of the woolless breed of sheep described in the *West Indian Bulletin*, (Vol. IV, p. 187). They are hardy and well suited to West Indian conditions. They are also regarded as the most profitable of any of the mutton breeds. The flesh is of excellent quality and much appreciated in the West Indies.

AGRICULTURAL LOAN BANKS.

It is deserving of mention that the only Agricultural Bank established by law for issuing loans to members of the planting community is that recently established at Barbados. Particulars in regard to 'The Sugar Industry Agricultural Bank' will be laid before the Conference by the Hon. F. J. Clarke, C.M.G.

An Act (No. 4 of 1907) to regulate advances in aid of the Cotton Industry has been in force in the Leeward Islands,

Latterly its operations have been confined to Montserrat, Nevis, and Anguilla. The advances were made to large and small estates. In most cases, however, the borrowers were persons of small means. A study of the experience gained in this instance would be useful in pointing out some of the difficulties to be avoided in any similar scheme in future. With this object in view, I propose to invite Dr. Watts, who for some time was in charge of the cotton loans in the Leeward Islands, to make a brief statement at this Conference.

It is also interesting to add that Co-operative Loan Banks for peasants are being continued in Jamaica, the money for loans being provided by deposits made by the people themselves. Mr. Fawcett reports that several banks have been started and that at least two of these are in operation, viz., the Trinity Ville Bank and the Christiana Bank. A paper on the latter was presented by the Revd. W. Turner at the Jamaica Conference (*West Indian Bulletin*, Vol. VIII, p. 250). This Bank commenced to make loans to its members in May 1906, and on December 31, 1906, eight loans had been made, one of which had matured and had been repaid: £38 were out on loan. With a membership of twenty-five, the income for the year was £28 6*s*. 5*d*.; the total funds of the Bank were £57 8*s*. 3*d*. The Chairman congratulated the members on the very satisfactory character of the first report. It was considered very satisfactory that the Bank had now nearly £60 to its credit and that it was steadily increasing. The loans made during the year had been for the purchase of stock and land, and for improving cultivation.

It may be suggested, with the view of meeting the requirements of small rice growers in British Guiana, that advances might be made on the lines of the cotton loans in the Leeward Islands, or efforts made to start Co-operative Loan Banks on the lines of those at Jamaica. In regard to the latter, it is important to bear in mind that each bank should deal with a limited area, so that those who advance the money are immediately in touch with the borrowers, and can judge for themselves as to the manner in which the money is applied.

AGRICULTURAL SHOWS AND EXHIBITIONS.

Successful agricultural shows continue to be held in the various colonies, and they are exercising a beneficial influence in drawing greater attention to the better cultivation and preparation of produce, and to improvement in the breeding of horses, cattle, and small stock. They also serve to bring into prominence the distinctive productions of each colony.

In addition it is gratifying to record that increased importance is now attached to the display of West Indian products at exhibitions in the United Kingdom and in Canada. In connexion with the former, this Conference would desire to acknowledge the valuable services rendered by the West India Committee in London and its indefatigable Secretary. The Canadian exhibitions last year were exceptionally successful. They have been the means of bringing before the people of the

Dominion, in a striking manner, the rich and varied productions of these colonies.

A Permanent Exhibition Committee now exists in every colony and these Committees are provided with funds so that they are enabled to take prompt and effective steps to get exhibits together and, what is of equal importance, to send with them attractive literature containing a description of the colony with notes on the commercial products in each case. In these days, we cannot wait until produce is asked for. We must take advantage of every opportunity to let people know what we can supply, and establish a reputation for produce of the character and quality required.

PRIZE-HOLDING SCHEMES.

A Prize-holding Scheme which has been in operation in Jamaica for many years is regarded as most valuable. It is also of great assistance to the Agricultural Instructors in enabling them to show practically how effect may be given to their recommendations. The scheme is for the encouragement of the cultivation of peasant holdings, and it also takes the house and sanitary conditions into account in the awards made. Only persons holding not more than 20 acres of land are allowed to compete, and the residence must be on the land entered for competition. Fifteen prizes are offered in each parish and they range in value from £4 to 9s. The judging is conducted on a system of points as follows: Permanent crops, 30 points; catch crops, 15 points; fences, gates, and general condition of the holdings, 15 points; live stock, 20 points; house, 10 points; sanitary conditions, etc., 10 points. Referring to the parish of St. Ann the Judges state: 'We desire to congratulate the Agricultural Society on the wonderful response to their efforts to improve small holdings as manifested in the preparations and improvements in the holdings submitted for inspection. We feel sure that in no other way could such improvement, such interest, and such an amount of labour be excited, with the expenditure of so little money.'

The Board of Agriculture at British Guiana has arranged for prizes to be offered at Farmers' Competitions as follows: (*a*) plots of ground provisions of not less than 1 acre; (*b*) plots of coffee cultivation containing not less than forty trees; (*c*) plots of fruit cultivation of at least ½ acre and of not less than six varieties of fruit trees; (*d*) plots of cane cultivation of not less than 1 acre. At a meeting of the Board of Agriculture held on March 27, 1907, the sum of $120 was contributed towards the Farmers' Competition on the East Coast between Buxton and Mahaica.

A Prize-holding Scheme for encouraging greater attention being devoted to the cultivation of small cacao plots in the colony of Grenada was started in 1904. The Judges in their report for 1906 stated that the extension of the Prize-holding Scheme was likely to be most beneficial in improving peasant holdings and deserved the warm support of the Government. The scheme is now being extended to two parishes in Grenada and the prospects are most promising.

At Barbados somewhat similar results have been obtained by the institution of Peasants' Exhibitions, which have been successfully carried out under the auspices of the Imperial Department of Agriculture during the last seven years. It is hoped that these peasant shows will now be continued by contributions from local funds.

I regard these prize-holding schemes and peasant exhibitions as most valuable agencies for improving the general condition of the holdings of small proprietors, and I heartily recommend them for general adoption. If properly organized, the actual cost should be comparatively small. A sum of £50 would be sufficient to start a prize-holding scheme in a fairly large district or to provide prizes for a peasants' show in any of the Windward or Leeward Islands, and Barbados. The essential point is that whichever plan is adopted, it should be adapted to local conditions.

AGRICULTURAL EDUCATION.

This is an important subject to be discussed at this Conference. It is impossible within the limited time at my disposal to present more than a brief sketch of the efforts that have been made in this direction.

The teaching of agriculture in Elementary Schools has made fair progress at Jamaica. In 1900, only six schools received special grants, amounting to £32, for teaching agriculture. In 1906, the number of schools had increased to ninety-two, and the special grants to £227. The annual courses of instruction in theoretical and practical agriculture given to the teachers at the Mico Training College have been continued. These courses last for a month, and the annual attendance has usually been about sixty.

At British Guiana, three Government school gardens have been established at Georgetown. In addition, it is reported that the managers and teachers of over fifty schools have started small gardens in their own districts. These latter are earning about 80 per cent. of the small grant offered under the Code Regulations.

In Trinidad during the last year, 203 schools were examined in practical agriculture. Steady progress is reported from all parts of the island. The formation of school gardens is hindered by the want of suitable land, and by other difficulties. Five horticultural school shows are annually held in Trinidad and Tobago.

At Grenada, agricultural education in Elementary Schools appears to have declined during the last two years and nothing worth mentioning is being done at present. Matters are practically at a standstill also in the Elementary Schools at St. Vincent. Moderate progress is reported from St. Lucia.

At Barbados, forty-one boys' schools and three girls' schools presented children at the annual examinations in Object lessons. About one-third of these had school gardens or showed plants under cultivation in pots or boxes. It is stated that the school gardens are decidedly better managed than before and the number has increased to twenty-one. The school exhibits at the

Peasant Exhibitions reached a higher standard than at previous shows, and evinced great care and attention on the part of the children.

At Montserrat, five school gardens have been started and it is reported that very good results have been obtained in the cultivation of various kinds of vegetables. Theoretical instruction is also given in school hours.

At Antigua, efforts have been fairly successful in introducing and encouraging the teaching of agriculture and the formation of school gardens. So far school gardens have not been successful at St. Kitt's. On the other hand, at Nevis, school gardens have had greater success, and at the Agricultural Shows the schools have always been well represented.

The Agricultural Training Schools at St. Vincent, St. Lucia, and Dominica, where selected boys from fifteen to eighteen years of age are boarded and taught for a period of three years, have clearly demonstrated the value of such training in raising the standard of cultivation, and in spreading sound knowledge as to the treatment of cultivations. About seventy boys trained at these schools have already obtained employment as foremen and overseers, or are otherwise engaged in Agricultural work.

Agriculture in secondary schools and colleges is making steady progress in Harrison College, Barbados, at Queen's Colleges at British Guiana and Trinidad, and at the Jamaica College. The number of boys who have passed through the agricultural classes at Harrison College during the years 1902-7 inclusive, is seventy-two. Of these eighteen have been awarded the Certificate of Proficiency in Agricultural Science and four more boys will probably receive the Certificate when the results of the Cambridge Examinations are known.

In 1903, the teaching of chemistry, botany, and agricultural science was introduced into the curriculum of Queen's College, British Guiana. Mr. E. W. F. English is the Lecturer, and considerable interest is being manifested in this branch of knowledge. Pupils of the Queen's Royal and St. Mary's Colleges, Trinidad, are given instruction at the Government Laboratory by the Professor of Chemistry and his assistants in agricultural science, including elementary chemistry and botany. At Jamaica, pupils of the Jamaica College are enabled to make use of the Government Laboratory. During the past four years, praiseworthy efforts to carry out a scheme of higher agricultural instruction in Jamaica have been made at the Government Laboratory, with the assistance of the Lecturer in Agriculture, the Assistant Superintendent of the Experiment Station, and the Science Master at the Jamaica College. Seven students attended the course of study in Agricultural Science during the year ended March 31, 1907. Of these, five presented themselves for the Diploma Examination of the Board of Agriculture and were all successful. Professor J. P. d'Albuquerque, of Barbados, who examined, reported favourably upon the work sent in.

Agricultural science is also taught at the Grammar Schools at Antigua and St. Kitt's by competent masters, and scholarships are being provided by the Imperial Department of Agriculture.

AGRICULTURAL PUBLICATIONS.

The issue of literature relating to agricultural subjects in all parts of the West Indies still continues. The *Bulletin* of the Department of Agriculture at Jamaica and the *Journal of the Jamaica Agricultural Society* maintain a high place amongst such literature. I would also mention the quarterly *Bulletin* issued by the Botanical Department at Trinidad, and the *Proceedings* of the Trinidad, Grenada, and Dominica Agricultural Societies. The first number of a quarterly publication entitled *The Journal of the Board of Agriculture of British Guiana* has lately been issued.

The Imperial Department of Agriculture has continued the publication of the fortnightly *Agricultural News* (Vols. I to VI.), and the quarterly scientific journal, *West Indian Bulletin* (Vols. I to VIII).

In addition, the following Foolscap Progress Reports have been issued:—

'Report of the Agricultural Work carried on at Barbados for the season 1904-6:—Parts I and II, Manurial Experiments. Part III, Varieties of Sugar-cane.'

'Report on Experiments conducted in the Leeward Islands with Sugar-canes in the season 1905-7:—Part I, Varieties of Sugar-cane. Part II, Manurial Experiments.'

The following numbers of the Pamphlet Series have been issued:—

(44) 'Seedling Canes and Manurial Experiments at Barbados, 1904-6.'

(45) 'A.B.C. of Cotton Planting,' New and Enlarged Edition.

(46) 'Seedling and other Canes in the Leeward Islands, 1905-6.'

(47) 'Manurial Experiments with Sugar-cane in the Leeward Islands, 1905-6.'

(48) 'Hints for School Gardens.'

(49) 'Seedling Canes and Manurial Experiments at Barbados, 1905-7.'

Also the following Leaflets: 'The Treatment of Anthrax,' 'The Treatment of the Cotton Worm,' 'The Scale Insects on Cotton,' 'The Useful Timber Trees of Dominica.'

The following Annual Progress Reports (with illustrations) on the Botanic and Experiment Stations have been issued, viz: Virgin Islands; Grenada; St. Kitt's-Nevis; St. Lucia; Dominica (in the press); Montserrat (in the press). Also a Report of the Veterinary Surgeon at St. Vincent, and a Handbook of the West Indies for distribution at the Canadian Exhibitions

A new and enlarged edition of 'Nature Teaching,' forming an illustrated volume of about 240 pages, is in the press, and will shortly be issued.

SUMMARY.

This is a brief review of the position and prospects of agricultural effort in the West Indies during the last few years. The main object has been to uplift the West Indian Colonies into the view of one another and into the view of the Mother Country and Canada and of capitalists and markets everywhere. Many of the facts brought forward will be supplemented in fuller detail by information to be laid before the Conference by those who have taken so active a part in the work. In estimating the results of previous Conferences, I believe we are justified in regarding gatherings of this character as of the greatest possible value in organizing our efforts and maintaining them on uniform lines so as to produce the best results. There is now harmony of action and sympathetic interest taken in agricultural matters in all portions of these colonies. The West Indies have shown that they are capable of steadily responding to a scientific ultilization of their resources. They have also fulfilled the reasonable hopes that have been entertained in regard to the possibility of improving old and the successful development of new industries. Twenty-four years ago, in a paper read before the Royal Colonial Institute, I endeavoured to place before the English people reasons for believing that there was even then a prospect of the West Indian Colonies entering upon a more prosperous career. Four years later, in an address delivered before the London Chamber of Commerce, I expressed confidence—a confidence in which I have never wavered—that there was a hopeful future before these colonies and that it was within the power of the people themselves to realize that future and to bring back something of the former affluence of the West Indies.

Since then, we have gone far and 'done things.' We have interested one of the largest manufacturing industries in Great Britain in our welfare. We have been told 'that if it had not been for the fine Sea Island cotton produced in the West Indies during the past few years, it is probable that a good many of the mills in Lancashire using the finer grades of cotton would have been obliged to work short time owing to the scarcity of the raw material.'

Still more recently, we have attracted the attention and warm sympathy of our vigorous and thriving kinsfolk in the Dominion of Canada, and there are possibilities in that direction also that may be pregnant of good to the West Indies.

A strong pull and a long pull should enable us to overcome many of the difficulties that now confront us. We would thus place the West Indies in the way of taking full advantage of the numerous and valuable resources which, as I have shown, are lying everywhere within their reach. (Applause.)

The Hon. FORSTER M. ALLEYNE (Barbados): At the Agricultural Conference held in Trinidad in the year 1905, I alluded to the thirty-nine representatives as the thirty-nine articles. These thirty-nine articles I am told this year, have now expanded to eighty. I do not know how to symbolize the number of

eighty except to allude to the Eighty Club in London, and I do not think most of us would belong to that. I congratulate Sir Daniel Morris on the number of delegates who have responded to his invitation to attend this Conference. It shows that these distinguished men would not have come so many hundreds—in some cases thousands—of miles and incurred time, trouble, and expense to attend a Conference of this kind if they did not think it would result in some real and lasting good; and as this is the seventh time on which it has been held, we must take it for granted now, that the value of these Conferences has been proved. Therefore, I must repeat to you my congratulations. If there is any truth in the statement that 'in the multitude of councillors there is wisdom,' then this Conference of eighty members ought to be a very successful on indeed. I believe that it will be. I believe we have come here to work, not only during the arranged nice little excursions, and so on, but by sitting down here in this Conference room for solid work. You have given us in the programme which I hold in my hand a most ample bill of fare. I hope we shall approach it in a voracious spirit and swallow the whole thing. If we do that we shall have done a great deal, and I hope it will be of lasting benefit to the West Indies. You have given an exhaustive account of the industries of the West Indies and have taken us over all the points and facts which you think we ought to take hold of. That is to say, you have given us an account of the industries which you think may be most successfully developed, and which, if developed, by means of care and attention and improved appliances, may make each of those industries successful, and so restore the old prosperity of the West Indies on a renewed basis. We hope so too, and we hope that by the aid of these Conferences and by other means we may develop those industries successfully. It is no part of my business to traverse your statements, and at any rate it would be impertinent on my part to criticize them. I can only say as regards the sugar-cane experiments here in Barbados, of which an account was given by Professor d'Albuquerque and Mr. J. R. Bovell at the Planters' Hall, Bridgetown, last Friday evening, that the progress that has taken place in the last three years is sufficient to develop hope in any one here. These experiments, although they have been going on many years, may be said to be still in their infancy, because there is so much that remains to be done. Already so much has been done that we see ourselves almost on the immediate prospect of developing seedlings, which, judging by the early promise if they give anything like what they ought to, should produce in the future—not a cane but canes—that should be a weapon with which we might be able to go on with confidence in the great struggle of Cane *versus* Beet. It is my humble part, to-day, merely to move a vote of thanks to you for your admirable address which will put new hope in us in the West Indies not only as regards the sugar-cane industry, but all those other industries to which you have alluded. I now ask this Conference to pass with enthusiasm a vote of thanks to you for the lucid, admirable, and comprehensive address which you have delivered to us. (Applause.)

The Hon. E. St. John Branch (Leeward Islands): It is with the greatest pleasure that I rise to second the vote of thanks to Sir Daniel Morris for the able and very interesting address delivered here to-day, and I do so with the greater pleasure and satisfaction as I am a representative of a colony which is deeply sensible of the benefits which have accrued to it owing to the presence in its midst of a well-equipped Department of Agriculture. The efforts of Sir Daniel Morris and his able lieutenants have been a conspicuous success in the Leeward Islands, and although it would be too much to say that to these efforts are due their promising financial outlook, yet undoubtedly they have largely contributed to it. Isolated facts and the observations of individual planters, it seems to me, are of little value in themselves, but when the work and knowledge of each individual is absorbed and correlated with that of others, we have a valuable aggregate which brings about important and sometimes unexpected results. It is in this direction that the Department of Agriculture has been conspicuously successful. Before I sit down, I may perhaps be allowed for a moment to touch on a more personal topic and to congratulate Sir Daniel on having so soon after the disastrous events which attended the Conference of last year in Jamaica succeeded in gathering around him so distinguished an assemblage as we see here to-day. That Conference in Jamaica opened with a most brilliant promise. It ended in a manner that some of us here too well remember. But we all recollect the rare and brave optimism with which Sir Daniel Morris then met what must have been to him a bitter disappointment, and what must be a lasting disappointment to all of us. The qualities which enabled him to do that and the preseverance which enabled him to retrieve the fallen fortunes of that Conference must command for him respect and admiration everywhere, and not least in this old-established and very, very British colony in which we have the good fortune to be present to-day. (Applause.)

Sir Daniel Morris: It is hardly possible in the few words I address to you now, to adequately thank you for your kindness in responding to my invitation to come to this Conference, for the large gathering here to-day, and for the very kind words that have fallen from my friends Mr. Forster Alleyne and Mr. Branch. Of all the work of the Conference, this is possibly the most difficult part of my duty—that of adequately thanking you for the very cordial reception you give me and for the appreciation of my services in connexion with agricultural work in the West Indies. I have now for many years taken an active part in this work. I am more than ever convinced of the ultimate success of it. As Mr. Alleyne has told you, there is strong evidence that we are moving slowly, but surely, in the direction of improving the condition of the sugar and other industries in the West Indies. I will not detain you any longer– I have already occupied a very large amount of your time this afternoon—except to express again my deep appreciation of the kindness shown me. I would also as on former occasions

place on record my great indebtedness to my colleagues who are working with me in this island and in other parts of the West Indies. Also I desire to express my appreciation of the support I have received from those in authority in the various olonies and from the members of the Legislature and of the Board of Agriculture and Agricultural Societies. Wherever I go in the West Indies, I am received in the kindest possible manner. I find also that the officers of the Department are, without exception, receiving the warm support and the confidence of the people among whom they labour. In a few years more we shall find a perceptible change taking place in all parts of the West Indies, and I look forward to the day when the West Indies will resume some of their former prosperity. (Applause.)

I would add that the Conference will resume at 11 o'clock to-morrow morning. I ask the constant and regular attendance of every member of the Conference in order that we may be able to get through the large programme of proceedings. There are many very interesting problems to be brought before you, and I trust before the Conference separates, we shall feel that we have got through a large amount of work, and that we have been able to place before the agricultural communities of the West Indies information likely to be of value to them.

I would now invite you to accord to his Excellency your appreciation of his courtesy in coming here, and of the cordial manner in which he has welcomed you. I have found his Excellency most willing to help in the work of the Department of Agriculture, and his presence here to-day is further evidence of his kindness.

I would mention that the proceedings of this Conference are open to the general public. We shall meet from day to day, and those gentlemen who are either resident in the island or visitors are welcome to come in and listen. I need not detain you longer. I hope to have the pleasure of meeting you in Conference to-morrow

The Conference then adjourned until 11 a.m. on Wednesday.

The programme of proceedings indicating the matters to be discussed on the subsequent days together with advance copies and proof sheets of the papers to be read were circulated amongst members. The subjects, however, were not necessarily to be taken in the order there given.

ABSTRACT OF PROCEEDINGS.

The regular business of the Conference was proceeded with on Wednesday, January 15, at 11 o'clock.

SUGAR INDUSTRY.

The PRESIDENT in a few opening remarks briefly referred to the experiments that had been conducted throughout the West India Islands, and called upon Professor J. B. HARRISON, on behalf of British Guiana, to open the discussion on the results of 'Recent Experiments with Seedling and other Canes, to-

gether with Manurial Experiments with sugar-cane in the West Indies.'

·Professor HARRISON reviewed the work that had been carried on at British Guiana up to the end of 1907 and submitted a limited number of his 'Progress Report in Agricultural Experiments for 1906-7.' It was stated that 30,000 acres were occupied in British Guiana with varieties other than the Bourbon and that a very considerable proportion of the total sugar area of the colony was being cultivated in new seedling varieties. In 1899, about 550 acres were occupied by new seedling varieties in the colony. The opinion was expressed 'that there can be no doubt that it is advisable for cane farmers on the coast-lands to plant either D. 109, D. 145, D. 625, or B. 147 in place of the Bourbon, whilst farmers on the lighter river-lands should try D. 145 or B. 208.

Reference was also made to the experiments that had been commenced to inquire into the effects of long-continued manurings of sugar-cane lands with sulphate of ammonia and with nitrate of soda, and whether better results would not be obtained by the substitution of one nitrogenous manure for the other. The results of the experiments show that the substitution of nitrate of soda on non-limed land for sulphate of ammonia, continuously applied for fourteen years, was attended by a reduction of the increased yield, due to the nitrogenous dressing from 12·1 tons to 10·3 tons, whilst the substitution of sulphate of ammonia for nitrate of soda on the 'nitrate' fields, increased the yield from 8·6 tons to 9·2 tons per acre. On limed soils, the substitution of nitrate of soda for sulphate of ammonia reduced the yields due to nitrogenous manuring from 11·8 tons to 8 tons per acre, whilst the change of sulphate of ammonia for nitrate of soda on the nitrate plots practically did not affect the yield. These are the result of only one series of experiments, but the apparent ill-effects of long-continued nitrogenous manurings were far more noticeable when nitrate of soda had been continuously used than where sulphate of ammonia had been, and indicated that on very heavy clay soils, under tropical meteorological conditions, the de-flocculation caused by long-continued dressings of nitrate of soda is likely to prove more injurious to the soil than is the souring action of sulphate of ammonia. The results also suggest that the injurious effects of nitrate of soda are more marked on limed land than on not-limed land, probably due to the liberation of free alkali in the soils during the de-flocculation caused by the nitrate of soda. Where soils, especially on the lighter lands of the colony, have been manured continuously for from thirty to fifty years with sulphate of ammonia, its souring action may have become marked, and decreases in yields may have resulted therefrom. A cure for sourness lies in an application of lime and not solely in changing the use of sulphate of ammonia to one of nitrate of soda. Manurial experiments with phosphates showed results that confirm the conclusion arrived at, that if a heavy clay soil in British Guiana yields more than ·008 per cent. of phosphoric acid to 1 per cent. citric acid solution under conditions of continuous shaking for five hours, manuring with

phosphates in all probability will not produce commensurately increased yields of sugar-cane. Until recently, large quantities of slag phosphates were yearly imported, but, now, as the result of fourteen years' field experiments, the planter is able by submitting a properly drawn sample of the soil, to which he contemplates applying slag phosphates, for analysis, to decide as to the advisability of such an application. Considerable economy has ensued from the adoption of this course, and this conclusion is an important one for the guidance of planters in British Guiana. Seedling canes have also been produced from arrows of the more promising varieties. At present, in addition to the seedlings obtained in 1904, 1905, and 1906, there are 335 varieties of canes in cultivation on the Experimental Fields, of which 143 kinds are being experimented with on fair-sized plots.

Hon. FRANCIS WATTS, adverting to the point brought forward by Professor HARRISON in connexion with the acidity of the subsoil, said it was a matter which was deserving of further investigation. In Antigua there were large areas where saline water existed, which he believed was of a different character and brought about by different agencies than those referred to by Professor Harrison. Subsoil drainage, he thought, for Antigua, impossible.

Hon. B. HOWELL JONES, speaking as a practical planter, pointed out the necessity of planters co-operating with scientific men in carrying out experiments with new varieties of sugar-cane, if the sugar industry of their colony was to reap the full benefit. One thing which the experiments conducted in British Guiana had taught the planters there was this: that they should be cautious in stating that a cane of a certain variety was so much superior to a cane of another variety. A cane which suited one locality might prove a failure in another—conditions of soil and climate had always to be taken into consideration.

In closing the discussion, The PRESIDENT observed that it was always to be borne in mind in connexion with the experiments carried on at the Botanic Gardens in British Guiana, that the soils were remarkably stiff, and the conditions existing there were such as possibly existed no where else in the West Indies. There were also great variations in the soil and conditions in different districts in British Guiana. Hence, it should not be a matter of surprise if a certain cane proved a failure in one locality and was regarded as the best variety in another. That being so, he did not think that Barbados, British Guiana, Jamaica, or Antigua was in any way prejudiced because a cane that gave good results in one colony did not yield high returns when planted in another colony.

Professor J. P. D'ALBUQUERQUE (Barbados) followed, on behalf of Mr. J. R. BOVELL and himself, with a paper dealing with the results of the experiments with sugar-cane carried on at Barbados to the end of the season 1905-7. He referred to the pamphlet, containing a summary of the results obtained on the experiments with varieties, which had recently been issued by the Imperial Department of Agricul-

ture, and which was in the hands of members of the Conference. Further and successful progress had been made in the direction of cross fertilization, with the object of producing seedling canes whose parentage (both male and female) were distinctly known, and an extended series of experiments has been inaugurated by Mr. F. A. STOCKDALE, as outlined in the *West Indian Bulletin* (Vol. VIII, pp. 79-90), for the purpose of raising new varieties by hybridization. The experiments with seedling canes at Barbados showed that many seedlings gave indicated yields greatly superior to those given by White Transparent, the standard cane, but it was stated that although it was not anticipated that such superior results would be shown by these canes when planted over larger areas, yet it was hoped that a large number of them would maintain a practical advantage in yield over that variety. By these experiments, the planters are enabled to decide what varieties are best suited to their different soils and climatic conditions, but it must be left to the planters themselves to ascertain experimentally what canes they will plant upon a large scale. The fact that 8,000 acres are planted in seedlings in Barbados indicates that the planters are fully aware of the good qualities of these newer varieties. It is also interesting to note that many Barbados raised seedlings have done exceptionally well outside the island.

The manurial experiments indicate that a normal application of farmyard manure plus nitrogenous artificials is to be recommended, and that such manurial treatment gives better results than those given by additional applications of farmyard manure to the normal quantity applied on the estates. The application of phosphatic and potassic manures had given varied results, and, in some instances, notable increases of yield were recorded.

Mr. A. P. COWLEY (Antigua) mentioned that the manurial experiments at Barbados showed that artificials added to farmyard manure gave increased yields, while the experiments at Antigua gave results which indicated that a normal application of farmyard manure was quite sufficient for the successful growth of plant canes. Such differences as these indicated the necessity of having established reliable experiments in the different islands, and the results obtained showed the necessity of having a well organized Agricultural Department in their midst. Information was also asked for in reference to the difference of results obtained from seedling canes when planted at different periods of the year, and to the length of maturity of several of these canes.

Professor D'ALBUQUERQUE briefly replied, and the PRESIDENT drew attention to the different periods taken to reach maturity in the cases of seedlings B. 208 and B. 147—the two canes instanced by Mr. COWLEY.

The following Committees were appointed:—

Education Committee:—His Lordship the BISHOP OF BARBADOS (Chairman), the Revd. H. A. DALTON, Professor J. P. D'ALBUQUERQUE, Dr. LONGFIELD SMITH, the Revd.

CANON REECE, Mr. J. R. WILLIAMS, Mr. J. H. COLLENS, Hon. FRANCIS WATTS, Professor HARRISON, Mr. T. A. POPE, Mr. C. F. CONDELL, Mr. A. H. KIRBY, Professor CARMODY, and Mr. WALTER BIFFEN (Secretary).

The Tobacco Committee:—Hon. W. FAWCETT, Mr. J. R. BOVELL, Hon. B. HOWELL JONES, Mr. J. C. MOORE. Mr. R. D. ANSTEAD, Mr. W. N. SANDS, Hon. FRANCIS WATTS, Mr. F R. SHEPHERD, and Mr. JOSEPH JONES.

The Conference then adjourned for luncheon.

Upon the resumption of business, Hon. FRANCIS WATTS (Leeward Islands) gave a summary of the results of the experiments that have been carried on with seedling and other canes in Antigua and St. Kitt's. It was stated that the inability to raise a large number of seedlings in Antigua and St. Kitt's was due to the fact that high, dry winds and, frequently, drought prevailed at the time when the canes were arrowing. They, therefore, were dependent upon supplies from the Experiment Stations at British Guiana and Barbados. The row method of experiments was adopted for testing new varieties of canes before introducing them into cultivation on a large scale. This method had proved satisfactory and large areas of seedling canes are now planted in Antigua and St. Kitt's. It was stated that 26 per cent. and 71 per cent. respectively, of the total sugar-producing areas of these colonies was occupied by seedling canes.

It was further mentioned that a striking feature about the Antigua experiments was the difference in the time required by the different varieties to come to maturity. B. 147 usually took about sixteen or seventeen months, while B. 208 matured in about twelve months.

Manurial experiments had been conducted. They show conclusively that artificials are not to be recommended for application to plant canes if the ordinary application of farmyard manure is given. The experiments with ratoons are divided into two series, and the results are published annually in pamphlet form and in the large Reports by the Imperial Department of Agriculture.

Hon. FRANCIS WATTS next read a paper on the results of the Central Sugar Factory in Antigua, which showed that this factory was successfully worked on co-operative lines and was making a substantial profit. Estates other than the original contractors were anxious to sell their canes to the factory. In answer to enquiries he expressed the opinion that unless factories were run on co-operative lines, in countries where muscovado sugar was chiefly made, there was little likelihood of success.

This factory was erected as a pioneer one designed to solve the much debated question of whether it is prudent, or desirable, under the conditions in the Leeward Islands, to abandon the muscovado method of sugar manufacture for the methods of modern factories. In 1907, the season just ended, 4,280 tons of sugar have been made from 40,782 tons of canes,

as compared with 2,348 tons of sugar from 24,676 tons of canes in 1906, and 1,634 tons of sugar from 15,860 tons of canes in 1905. The position of the original contracting proprietors may be summed up as follows: they have sold 62,274 tons of canes and have received £28,501, or 9*s*. per ton by way of first payment, £7,367, or 2*s*. 4*d*. per ton by way of cash bonuses; making a total of 11*s*. 4*d*. per ton of canes, and have invested £3,341 or 1*s*. 0¾*d*. per ton of cane in the factory. The A shareholders have received 5 per cent. interest on their money and, in addition, cash bonuses of £5,115, equal to 20·4 per cent. in three years on the capital invested by them or 6·8 per cent. per annum. This is equivalent to 11·8 per cent. per annum in all, and in addition, there is the investment in the factory of £3,341 out of the profits equal to 4·4 per cent. per annum.

It is also worth noting that 11*s*. 4*d*. per ton of canes is equal to 5·6 lb. of 96° sugar per 100 lb. of cane.

In course of the discussion that ensued,

The Hon. F. M. ALLEYNE (Barbados) enquired what it cost per mile to provide the railway lines belonging to the factory.

Hon. FRANCIS WATTS replied that the lines, including rolling stock, cost about £100 per mile.

The Hon. F. J. CLARKE (Barbados) asked whether there were many outside the original contractors who sent their canes to the factory, and at what rate were they paid.

Hon. FRANCIS WATTS replied that there were many estates which now sold their canes on a basis of 5½ lb. of sugar per 100 lb. of canes, which worked out at a little under 11*s*. 4*d*., and they were perfectly satisfied to sell their canes at that rate.

Mr. T. W. B. O'NEAL (Barbados) enquired whether the factory was a government one.

Hon. FRANCIS WATTS replied that it was a co-operative concern. The Government gave the residue of the Imperial Grant-in-Aid to assist in the establishment of a central factory, and that remains as a lien against the factory. They were under the obligation, however, to purchase not less than a certain quantity of canes every year from the growers at not less than 7*s*. 6*d*. per ton.

The PRESIDENT stated that out of 6,000 tons of crystals shipped from Antigua, nearly 2,500 tons represented the gain due to improved methods of crushing and manufacture.

Hon. F. J. CLARKE said that the conditions must be vastly different in Antigua from what they were at Barbados, because three years ago when the figures in connexion with the Antigua factory were published, some of the planters in Barbados took the trouble to weigh their canes, go into calculations and make comparisons with the figures of the Antigua factory. They found that with their muscovado process they did very much better than that factory and had realized fully 14*s*. a ton for canes. He had been furnished with statistics by several planters who weighed their canes and in every case they had found that they would have lost considerably by selling their canes to a factory at the prices paid at Antigua.

Hon. FRANCIS WATTS was of opinion that for the planter to get full value for his canes the factory must be worked on the co-operative principle.

The PRESIDENT pointed out that this point was specially emphasized in the Report of the Royal Commission, and until they could get a co-operative factory working in Barbados and owned by the people themselves, there was little chance of the aspect of things being materially altered.

Hon. B. HOWELL JONES asked whether the canes should not be paid for by contents rather than by weight, as the sugar-content of the juice of the sugar-cane varied considerably.

Hon. FRANCIS WATTS thought that so far, satisfaction was felt as to buying canes by their weight.

Hon. FRANCIS WATTS next gave a summary of a paper, under revision, on 'Observations on the work of sugar-cane mills, and deductions to be drawn therefrom.' Here it was suggested that the efficiency of a mill may be accurately measured by ascertaining the proportion of juice remaining in the megass in relation to the fibre; in other words, the quantity of first mill juice per 100 parts of fibre.

This factor permits of the comparison of mills working under the most diverse conditions either of the quality of the cane or juice, or of the character of the mills. Comparisons can be made between mills grinding either good or indifferent canes: it is immaterial whether maceration is used in one of the mills under comparison and not in the other—it even applies to such methods as the Naudet process wherein the megass is discharged, saturated with water. A direct comparison can also be made between any mill and the Naudet process irrespective of the quality of cane handled by each. Similarly, a single mill in a muscovado sugar works may be directly compared with a modern mill using maceration. It is of no consequence what quality of cane either mill deals with.

The Conference then adjourned to enable the Representatives to attend a reception at Government House.

The Conference resumed on Friday morning, January 17, at 10 a.m.

SUGAR INDUSTRY.—(*Continued.*)

Professor P. CARMODY (Trinidad) read a paper on 'Further notes on cane farming in Trinidad' giving statistics which showed the progress that had been made in the industry during the last two years; the number of cane farmers had increased to 328; 17,000-20,000 acres were under cultivation, and the number of farmers was still on the increase, the East Indian increasing more rapidly than the West Indian. The yield of canes was regarded as fair and it was thought that cultivation of sugar-cane by farmers in co-operation with central factories

was proving to be highly satisfactory. The stability of the sugar industry at Trinidad relied greatly upon the co-operative system of production.

Mr. J. R. BOVELL asked whether the land referred to by Professor CORMODY had not been out of cultivation for some time.

Professor CARMODY thought the land might be taken as fairly representative of the cane lands of Trinidad.

Hon. B. HOWELL JONES said that very little cane farming was carried on in British Guiana, the difficulty being the means of transport between the various villages and the estates.

Hon. FRANCIS WATTS said that the basis of trading in Antigua was somewhat different to that described by Professor CARMODY, although the effect might be somewhat similar. Peasants' canes were bought at the rate of 4½ ℔. sugar per 100 ℔. cane, which during last year realized 8*s*. 7½*d*. per ton of canes. He was unable to say how many acres there were in farmers' canes.

Hon. W. FAWCETT (Jamaica) said there was a small amount of cane farming going on in Jamaica at Westmoreland, where one or two small estates had abandoned their machinery and were selling their canes to larger estates. But there were no peasant farmers as in Trinidad.

Further discussions on matters relating to the sugar industry were postponed until the session of Monday morning.

SUGAR INDUSTRY.—(*Concluded.*)

On Monday morning, Mr. F. A. STOCKDALE (Mycologist on the staff of the Imperial Department of Agriculture) read a review of the root disease of the sugar-cane caused by *Marasmius Sacchari*. Of the fungus diseases of sugar-cane of the West Indies, this disease is considered to be the most important, and has probably caused more damage during the past few years than all other sugar-cane diseases together. A brief summary of the advance of knowledge of root disease of sugar-cane was given and attention was drawn to the efforts that were being made in other sugar-producing countries in fighting similar diseases. Instances of considerable losses throughout the West India Islands were cited, with a view to bringing forward the necessity for more thorough adoption of remedial measures. The root disease does damage in two ways: (1) It destroys the roots of plants and ratoons, and (2) it smothers the new shoots of ratoon stools. The symptoms of the disease were briefly referred to, and it was pointed out that it spread by three methods—(1) by the spores borne by the small toad-stool like fructifications, (2) by the mycelium that travels underground, and (3) by the planting of affected cane-cuttings. In discussing remedial or preventive measures, Mr. STOCKDALE stated that they may be divided into (1) cultural improvements, (2) sanitary measures, and (3) selection of varieties. The question of rotation of crops was fully dealt with and the best methods of disposal of infected material—such as rotten canes or trash

—were brought forward. Attention was also drawn to soaking cane-cuttings in Bordeaux mixture, and to the value of lime as a fungicide. It was brought to notice whether the good results that accrue, in many sugar-producing countries, from applications of lime are really due to the indirect manurial action or clay-flocculating effect, or whether they are not rather due to a considerable extent to the action of lime on the parasitic enemies of the sugar-cane. The use of lime on sugar lands in Hawaii has recently been on the increase and it has been mentioned that lime and cow peas have shown to be suitable treatment from a manurial point of view for many of the cane soils of Jamaica. Experiments might therefore be started throughout these islands with applications of lime, and the results viewed from a mycological, rather than a manurial point of view. Experiments conducted along the right lines might answer the question as to the fungicidal value of lime in the root disease of sugar-cane. Disease resistance of many of the seedling varieties was touched upon, and satisfactory progress in connexion with the breeding of hybrid canes for disease resistance reported. In Java where the root disease was first worked at by scientists, it is reported that Dr. Prinsen Geerligs states 'that it is now difficult to find specimens of the root fungus in Java.' The systems of rotation practised, together with the elimination of ratoon crops, as well as the great care taken with material for planting purposes have played an important part in bringing about this result.

Mr. J. R. BOVELL stated that about a month ago he took twelve sugar-cane cuttings, and soaked six in Bordeaux mixture and the other six in water only. These were planted out, and while those that were soaked in water only were affected by the fungus disease of cuttings, those soaked in Bordeaux mixture were unaffected. A fair amount of root disease was, at present, to be found in Barbados, and frequently planters used badly affected cuttings for planting purposes. Mr. BOVELL then exhibited a stool of canes badly affected with root disease, and also showed the specimens of cane-cuttings soaked in water and in Bordeaux mixture above referred to.

Hon. FRANCIS WATTS said that there was a fair amount of root disease of sugar-cane in the Leeward Islands. He was perfectly convinced, however, that they did not fully recognize the importance of taking every precaution against this disease. A planter frequently noticed the white felted mycelium upon the trash, but thought that it did not appear to be doing any damage to his canes. This was perfectly true. The fungus was then saprophytic in habit, and was present to do damage whenever the opportunity was given for its favourable development. This attack on the trash, however, was of greatest importance, for it was the means by which the fungus was spread in the ground. He further asked whether the fungus attacked such plants as guinea corn or imphee, and what was the precise definition of 'infected cuttings.'

Hon. F. J. CLARKE asked whether the dying out of canes in the fields at Barbados was always due to root fungus, for he had found that a grub was at the roots of some of the cane stools that he had examined.

The PRESIDENT drew attention to the pamphlet, that was prepared by Mr. Lewton-Brain in 1904, dealing with the fungus diseases of the sugar-cane, and stated that it was desired to draw the attention of all planters throughout the West Indies to the present position of fungus diseases of the sugar-cane. The Imperial Department of Agriculture had continually drawn attention to diseases of the sugar-cane, but he thought that it should be emphasized that the root disease of sugar-cane was, at present, doing damage—particularly amongst some varieties.

Mr. F. A. STOCKDALE stated, in reply to Dr. Watts, that cuttings should never be taken from affected plants. Although the fungus on the trash was mainly saprophytic in habit, it would be found on removal of that trash, that most of the sleeping roots at the nodes had been infected by the fungus, and therefore cuttings from such material could not give strong, healthy plants.

Continuing the discussion further, Mr. COWLEY stated that in Antigua, Bordeaux mixture was now generally used for soaking cane cuttings, and that the labourers had remarked its beneficial effect. Hon. F. J. CLARKE asked for information in respect to the disposal of infected trash and deep draining, while Professor HARRISON referred to the methods adopted in British Guiana against the root disease of sugar-cane. The system of dividing lands into sections in British Guiana by the cross drains seemed to prevent the fungus from spreading over wide areas.

The paper entitled 'Selective Cane Reaping at Jamaica' which was prepared for the last Conference at Jamaica and published in the *West Indian Bulletin*, (Vol. VIII, p. 109) was referred to. In ratooning districts, it was stated that good results followed the cutting of only the ripe, mature canes, and recommended itself for trial instead of 'cutting clean,' in places where ratooning is carried on for any considerable length of time.

CACAO INDUSTRY.

Hon. FRANCIS WATTS summarized, on behalf of Mr. JOSEPH JONES and himself, the results of experiments with cacao trees at Dominica.

Manurial experiments are carried on at the Botanic Station and in the country districts. Those at the Botanic Station have now assumed considerable interest, and as a result of experiments carried out there, planters are recommended to manure their cacao trees. Organic manures, such as pen manure and liberal mulchings, are doubtless the best and most remunerative. When these cannot be obtained in sufficient quantity, it is essential to give manures containing nitrogen and phosphate, and in many cases it may be well to supplement mulching with moderate applications of nitrogen and phosphate. The experiments afford no evidence as to the value of potash, and it is concluded that this constituent is not urgently

wanted, as the soils of Dominica are fairly well supplied. The plots in the country districts show that manures are beneficial and remunerative in the establishment of young cacao, and pen manure when obtainable, is likely to give the best results. Manures supplying organic matter are desirable as they tend to maintain the supply of humus, and every effort should be made to increase the humus in the soil as much as possible. The intelligent use of the weeds of a cacao orchard has given good general results, and the field is improving steadily. The weeds are allowed to grow to a moderate height and are then either cutlassed down or bedded in with the fork as occasion requires. When the plots were first laid out, attempts were made to keep weeds down thoroughly (clean weeding). The soil was deteriorating, but on altering the method of working, surprisingly good results followed.

Mr. A. P. COWLEY (Antigua) mentioned that pen manure was used in the various islands in the experiments of the Imperial Department of Agriculture and the results obtained probably varied according to its composition. He would like to know whether there was any standard by which to determine a complete pen manure.

The PRESIDENT pointed out that in the experiments carried on by the officers of the Department, the quality of pen manures used was considered as a 'good average,' and although the application of pen manures varied in quality on different estates, yet one could arrive at a fairly accurate idea of what results might be expected from applications of pen manure by taking averages over several years.

Hon. FRANCIS WATTS drew attention to cotton-seed meal, a manure that was generally of fairly uniform composition, and suggested that its use might be valuable in cacao cultivations.

Mr. R. D. ANSTEAD (Grenada) gave a brief review of the results of recent experiments with cacao at Grenada. The experiment plots are of two kinds, distinguished for sake of reference by the terms 'experiment plots' and 'experiment stations.' The experiment plots are each about 1 acre in extent and are chosen from land near the public roads, belonging to peasant proprietors. The experiment stations are established on large estates and consist of not less than 5 acres or 1,000 trees. The manurial experiments show that nitrogenous manures are of the greatest value for cacao, and that the use of phosphate without nitrogen is not beneficial. The use of potash without nitrogen, on the other hand, appears to result in increase of yield. The cacao soils of Grenada consist of stiff clays strikingly deficient in lime, so that the beneficial results obtained by applications of lime are not surprising.

Mr. A. R. C. LOCKHART (Dominica) referred, in an interesting address, to the valuable work done by Agricultural Instructors in helping small cultivators to improve the condition of their properties. He asked the PRESIDENT to consider the advisability of again recommending the filling of the post of Agricultural Instructor at Dominica.

The PRESIDENT stated that the post of Agricultural Instructor for St. Lucia was vacant, as well as that for

Dominica. Every effort was being made to obtain men to fill these posts, but it was difficult to obtain a suitable man with a good knowledge of the patois of those colonies.

Mr. J. C. MOORE (St. Lucia) briefly reviewed the position of the experiments with cacao at St. Lucia.

Mr. JOSEPH JONES (Dominica) read a brief paper on experiments in grafting cacao at the Dominica Botanic Station, summarizing the work done, and showing the results of these experiments up to the present time. Grafts have been obtained with alligator cacao (*Theobroma pentagona*) on Forastero stocks, and between hardy, prolific types of Forastero cacao on Calabacillo stocks. There are 156 grafted plants now growing in the Dominica Botanic Station, 136 in an experiment plot on an estate in the country, and over 200 plants are, at the present time, on order by planters from the station for further experiment.

Mr. J. H. HART (Trinidad) presented a paper on 'The necessity of improving the methods of planting cacao in the West Indies.' Allusion was made to the establishment of cacao estates in Trinidad by the 'contract system,' the general adoption of which appears to depend upon the fact that, under it, less immediate expenditure of capital is incurred. Moreover, the planter, when he has paid for the trees at the end of the term, at once gets some return for his money, as the majority of the trees will then be commencing to bear. Selection of seed from the very best trees should be resorted to, and grafting or budding from selected trees might be adopted. The advantages to be gained from budding or grafting are many, and are important. Therefore, every effort should be given to the production of uniform plantations of cacao. Trinidad cacao has obtained a name for certain good qualities, but manufacturers cannot use Trinidad beans alone, but need other cacaos of different qualities to obtain the blends they require. The West Indian cacaos lack those qualities necessary for making the flavours now recognized, but there could be no reason why an introduction of plants of foreign cacao should not be undertaken, and kept pure by budding and grafting, so that the West Indies might give the manufacturer the different blends required.

The PRESIDENT stated that the cacao supplied to the Royal Navy was a blend of different cacaos, such as Mr. HART had referred to. He alluded to the danger of introducing cacao beans from one colony to another from the disease point of view, and strongly urged that no cacao should be introduced for planting purposes from the continent of South America, owing to the presence there of the 'witch broom' disease. Most of the colonies had plant protection laws, but the greatest caution should be exercised against what has proved to be a most terrible disease of cacao orchards.

Professor HARRISON stated that the cultivation of cacao at the Onderneeming School Farm in British Guiana had received considerable attention during the past year. Each tree had been carefully pruned and brought into as good shape as possible. The drainage had been improved and a considerable reduction of shade made. When these plots were first started

they were heavily shaded, but reduction of shade and care in cultivation had produced considerable improvement. Larger crops were reaped and fewer diseases noticed. Attention was also drawn to the necessity of conducting experiments with larger units of fruit-bearing trees, and to control plots being also used.

Mr. F. A. STOCKDALE (Mycologist on the staff of the Imperial Department of Agriculture) presented a brief review of the 'Fungus diseases of Cacao in the West Indies and the Sanitation of Cacao Orchards.' A root disease, due to a Basidiomycetous fungus, that causes considerable damage to cacao in Dominica, St. Lucia, and Grenada was described, and remedial measures were given. It was stated that it had been noticed, in Dominica, that the cutting off of all diseased roots and treatment with lime had given fairly satisfactory results. Reference was also made to the attacks of the fungus on poisdoux, breadfruit, breadnut, etc., and it was pointed out that a dead or dying tree in any cacao orchard should immediately be removed. Those diseases of the stem described included the 'canker' disease due to species of *Nectria*, the 'die-back' due to *Diplodia cacaoicola*, the 'witch broom' disease of Surinam (also found in a few instances in British Guiana), the 'thread' blight, and the 'horse hair' blight. The symptoms of the several diseases were briefly given, and the remedial measures indicated. Reference was made to the good results that had been obtained in Ceylon in the treatment of their 'canker' and in some of the West India Islands in the treatment of 'die-back.' Three pod diseases were reviewed —the 'brown rot' due to *Diplodia*, the 'black rot' due to *Phytophthora*, and a disease, rarely found, caused by a species of *Nectria*. Diseases come to notice recently were more fully described and the latest information in respect to them was given. The disease caused by *Lasiodiplodia* is known to occur in Trinidad, Grenada, and Dominica. It affects the stems of the trees, and mycelial threads similar to those in the stem have been observed in the roots, but whether there is any connexion between them has yet to be demonstrated. The 'Pink' disease of Dominica caused by a species of *Corticium* was referred to, and the satisfactory results of remedial measures mentioned. The distribution of the different diseases was given, and their relative importance in the different islands reviewed. The question as to the relation between attacks of thrips and prevalence of 'die-back' was brought forward, and specimens of the different diseases were shown and discussed.

Hon. E. G. BENNETT (St. Lucia) said he had been very much puzzled in determining certain diseases that had been affecting his cacao estate, which was situated in the Cul de Sac district, but from the descriptions given by Mr. STOCKDALE, he was satisfied now that besides thrips and canker, his trees had been suffering from attacks of 'root disease' and 'die back.' One peculiarity of 'die back' was that notwithstanding manurial treatment and application of remedies recommended, there was a periodical appearance of the disease just about the time that the cacao was approaching maturity. With regard to thrips, whether they preceded *Diplodia* or followed it, he was not sure,

but his experience was that he noticed *Diplodia* long before he observed the thrips. Since reading the interesting papers by Dr. WATTS on the subject of mulching, which had been published in the *West Indian Bulletin*, he had commenced to mulch his trees, but had not been doing so sufficiently long to arrive at any accurate statement as to results.

The Hon. J. G. W. HAZELL (St. Vincent) asked what kind of tar was used for application to wounds made by pruning.

Mr. STOCKDALE replied that he thought coal tar was generally used, and mentioned that care should be taken in its application. It should be confined to the wound itself, and should not be smeared or allowed to run down the bark of the tree.

After a lengthy discussion, during which the symptoms of *Lasiodiplodia* were brought forward at length, the PRESIDENT, in concluding, mentioned that in Ceylon it was found to be an essential part of the treatment of canker to let in light amongst the cacao trees. The gradual removal of shade trees had a very beneficial effect in lessening the attacks of the disease. That was a matter which cacao planters in the West Indies should keep prominently in view in combating canker and similar diseases.

The Conference then adjourned for luncheon.

After luncheon, the PRESIDENT announced that the question of thrips on cacao would be dealt with, and the manufacture of commercial citrate of lime. Then the Hon. F. J. CLARKE would give a brief description of the Barbados Co-operative Cotton Factory, over which the delegates would be taken later that afternoon.

Mr. H. A. BALLOU (Entomologist on the staff of the Imperial Department of Agriculture) read a paper on 'Thrips on cacao trees in the West Indies.'

The distribution of thrips was given as Grenada, St. Vincent, St. Lucia, Dominica, and Guadeloupe in the West Indies, and Ceylon in the East. It was shown that thrips injure the cacao trees by punctures made in feeding and in egg laying, and thus may give access to fungus diseases.

Thrips may be controlled by improved cultivation, including all those operations which tend to make the cacao trees strong and vigorous. This was borne out by planters who have had experience of thrips in Grenada and other islands.

LIME JUICE INDUSTRY.

Hon. FRANCIS WATTS gave a brief account of the manufacture of citrate of lime in Dominica and Montserrat. He brought information up to date, and stated that the use of centrifugals in drying citrate had given very good results. He exhibited samples of centrifugal dried citrate and of the product dried by ordinary methods. The centrifugal dried citrate contained much less water than the ordinary product, and was also in a much better physical condition—there being few lumps.

COTTON INDUSTRY.

Hon. F. J. CLARKE (Barbados) then read a brief paper on the 'Origin and establishment of the Barbados Co-operative Cotton Factory.' It was mentioned that the first cotton factory was opened in July 1903, and was further enlarged in 1904. This factory was run by a Committee appointed by the Agricultural Society, in co-operation with the Imperial Department of Agriculture. The success of the cotton planting of those years suggested to the Committee that the time had arrived when the cotton industry should be carried on without any Government or other assistance. The Barbados Co-operative Cotton Factory, Limited, was registered under the Companies' Act on August 16, 1905. The factory was opened in January 1907, and is equipped with a double expansion engine, a Stirling water tube boiler, twenty-four gins, a hydraulic baling press and a seed disintegrator. It is hoped that, in the near future, oil-extracting machinery will be added. From small beginnings, and through many struggles, there has come into existence the largest Sea Island cotton factory in the world. The working of the factory has been highly satisfactory both to the cotton growers who have had their cotton ginned there, and to the shareholders who have received good dividends.

The Conference then adjourned to enable the Representatives to pay a visit to the Cotton Factory under the guidance of Mr. CLARKE and other gentlemen.

A reception was held by LADY MORRIS at Chelston at 4·30 p.m., at which the representatives to the Agricultural and Canadian Conferences were present.

The Conference resumed on Saturday, January 18, at 10 a.m.

Mr. J. R. BOVELL (Barbados) gave a review of the Sea Island cotton industry at Barbados. Judging from results so far obtained, the best time to plant cotton at Barbados was the beginning of July to the middle of August for the black-soil estates, and the beginning of August to the middle of September for the red-soil estates. Occasionally, cotton crops planted out of season have given good results, but these are exceptions. The manurial experiments show that the best results were obtained on the plots which received 30 lb. of nitrogen as sulphate of ammonia, 60 lb of phosphoric acid as superphosphate of lime, and 20 lb. of potash as sulphate of potash. The value of the increase in yield over the plot which received no manure was $7·77. The area planted in cotton has been increased from 5,000 acres to 6,935 acres, and it is estimated that the value of its production should be very close to £120,000. The need for more care in seed selection was particularly emphasized, for it was agreed that until the planters in the West Indies recognize the great importance to the industry of careful seed selection it will be impossible for the industry to make the advance it otherwise would. The valuable services rendered by Mr. T. THORNTON, Travelling Inspector in connexion with

Cotton Investigations, were alluded to, and regret expressed at his intended departure from the Imperial Department of Agriculture to undertake cotton planting at Tobago.

The PRESIDENT was glad to find that the prospects for cotton growing in Barbados this year were more favourable than they were last year. With regard to what Mr. BOVELL had said about Mr. THORNTON'S services, he wished also to mention that as Travelling Inspector in connexion with cotton cultivation, Mr. THORNTON'S services had been placed at the disposal of the planters of the West Indies through the generosity of the British Cotton-growing Association; he had been engaged with the work now for three years. During the whole of that time he had found Mr. THORNTON a very zealous and earnest officer, and he left the Department with its greatest regret. He trusted that in his own efforts in another part of the West Indies, Mr. THORNTON would be successful, and would be the means of affording a large amount of assistance and encouragement to the cotton growers of Tobago.

The Hon. FRANCIS WATTS (Leeward Islands) reviewed the position of the cotton industry in the Leeward Islands. The year 1907 has proved itself to be a further period of steady progress in the industry. Exports of cotton from the Leeward Islands in 1905 amounted to 383,477 lb. of lint; in 1906, 526,382 lb., and in 1907 there were exported 702,910 lb. At the present time, there are approximately 10,000 acres under cotton cultivation in the Leeward Islands and therefore it is not reasonable to expect that the acreage will increase very greatly for some time. During the next few years, increases in exports of cotton should result from improvements in cultivation rather than from greatly increased areas, and it is hoped that further increases in acreage will take place by reason of the gradual opening up of derelict and uncultivated lands, than at the expense of lands already under cultivation in sugar. The returns of lint exported from the various islands show very substantial increases on those of the previous year, with the exception of Anguilla, and of Nevis where bad seasons and prevalence of disease caused a reduced output.

At Antigua, a steady advance has been made. The character of the lint produced has continued good and uniformly high prices have been obtained. At the present time there are 2,508 acres under cotton at Antigua, and 150 in its dependency of Barbuda. The whole of the area at Antigua has been planted from seed raised in the island and selected under the supervision of the Agricultural Department by the Antigua Cotton Factory Company. Implemental tillage is being applied to cotton cultivation, but it is yet too soon to be able to form a reliable opinion as to the value of the results likely to accrue from the use of implements. Manurial experiments are being conducted and extensive experiments in seed selection have been commenced, by the Agricultural Department.

At St. Kitt's, 2,000 acres are under cotton, 1,500 as an intermediate crop with cane and 500 as a main or rotation crop. The prospects are good and the reports on the first shipments of cotton have been favourable. The condition of the

industry at St. Kitt's is most encouraging, and as cotton is grown almost entirely as an intermediate crop with cane, it has proved most remunerative and useful to the island. Manurial experiments have been continued, and seed selection experiments inaugurated.

At Nevis, there are 1,800 acres in cotton, notwithstanding the discouraging results of last season's crop. The appointment of an Agricultural Instructor has been the means of placing the smaller growers in possession of information that has resulted in a more intelligent treatment of the crop. The conditions of cultivation, etc., are very greatly improved and the prospects of a fair crop being reaped are hopeful. Cotton has become almost the only industry of the island.

Anguilla is estimated to have some 1,500 acres under cotton. The actual receipts, although the return of lint per acre seems to be lower than in other places, are very satisfactory to the small grower, and the importance of the industry can only be fully realized when it is remembered that four years ago there were no exports of value from Anguilla.

With reference to Montserrat, it was stated that probably in no island in the Leeward Islands, with the exception of Anguilla, has the cultivation of Sea Island cotton been productive of better results than in Montserrat. For the present crop, it is estimated that 2,002 acres are under cultivation, as against 1,050 in 1906-7, and cotton has now become the principal industry of the island. Peasant proprietors are responsible for the cultivation of 400 acres, and they have given an amount of care and attention to their crops that is praiseworthy to the extreme. It would appear that there is every promise of at least as good an average return per acre as was obtained last year.

The cotton industry of the Virgin Islands is entirely carried on by peasants and small cultivators. In order to aid in the development of the industry, it is the practice of the Government to purchase seed-cotton from the growers at rates governed by the current market prices. The seed-cotton is then ginned and shipped, and the proceeds are credited to the Government. This procedure has been adopted, as it would be difficult, if not impossible, to interest the peasants in a crop that makes it necessary for them to wait until the proceeds of the sale could be remitted them from England. There appears good reason for hoping that the development of the cotton industry in this presidency may be as productive of beneficial results as in the case of the islands of Anguilla and Montserrat.

Mr. W. N. Sands (St. Vincent) summarized the position of the Sea Island cotton cultivation in St. Vincent. This industry was commenced at St. Vincent in 1903-4, and in 1906-7, over 1,530 acres were planted. This year 3,200 acres have been planted, or an advance of over 100 per cent. on last season's acreage. Owing to a favourable season it is estimated that the value of the industry should exceed £45,000. The chief areas are planted from June to the beginning of August, but it has been found that those sown in July generally give the best returns. The St. Vincent Grenadines are producing excellent

Sea Island cotton, and it is now grown in practically all the islands. It is thought that it will soon take the place of the inferior Marie Galante or Union Island varieties in those islands. It was also being tried in the Carib country, that was devastated in 1902-3 by volcanic eruptions. St. Vincent cotton has attained a high standard in quality, and it appears to excel in lustre, fineness, and low percentage of weak fibre. Samples of St. Vincent cotton were then sent round by Mr. Sands, including one that fetched the highest price paid last year for any West Indian cotton, viz., 2*s.* 7*d.* per lb. Insect pests and fungus diseases are always present. The cotton worm has been observed in most of the cultivations in small numbers, but, fortunately, very little damage has been done. Its natural enemies, such as Jack Spaniards and a large burying beetle, have kept it in check. Among fungus diseases, anthracnose does a large amount of damage to the bolls, and experiments have been commenced with wider planting, larger applications of phosphates and potash, and with the use of fungicides, with a view to ascertaining the best means of keeping it in control. Cotton seed selection experiments have also been undertaken on seven estates.

The PRESIDENT remarked that he was greatly interested in the story given by Mr. SANDS, especially as that gentleman had taken so active a part in developing the industry in St. Vincent. In order to assist the planters at the commencement of the industry, the Imperial Department of Agriculture undertook to lay out a dozen experiment plots, to pay the whole cost of cultivation, to gin, bale, and sell the cotton and to hand over the proceeds to the planters, on condition that they followed the recommendations of the Department as to the methods of cultivation. The following year the planters took up the industry themselves and had developed it on such successful lines, that the name of St. Vincent Cotton was getting known everywhere. The planters, he thought, were to be congratulated on the success of the industry.

Hon. J. G. W. HAZELL (St. Vincent) said that before the introduction of cotton cultivation St. Vincent was in a very poor way—planters were on their last legs. Sir DANIEL MORRIS came to the rescue, experiment cotton plots were started, the planters readily carried on the cultivation on the lines indicated by the Department, and they were now reaping their reward. Last year they got top price in the market for their cotton. Encouraged by their success they had extended the industry to the Grenadines, especially in Mustique, where stock breeding was at present the principal industry, but where for a number of years and up to the time of the American war short-staple cotton was cultivated. They had succeeded in inducing the labourers there to go in for the cultivation of Sea Island cotton. The area under cultivation was gradually extending and the industry was proving a boon to the people.

Professor HARRISON said that the experiments in British Guiana with regard to cotton had been signally unsuccessful. Carivonica cottons imported from Queensland have been experimented with, but they have been found very subject to

the diseases so prevalent among cotton plants in cultivation in the colony, especially to anthracnose. Egyptian cotton has also been tried, and seed selection has been experimented with. There is considerable promise in this line of work, for the plants appear to be quite vigorous, and it is hoped to raise a strain that will flourish on the heavy clay lands of the colony.

Mr. A. D. C. ADAMSON (St. Kitt's) stated that he had tried the Carivonica cotton at St. Kitt's. The area was 1½ acres; he had been picking since March last and had got 1,200 lb. of seed-cotton at one picking and 1,060 lb. at another. There was a very large proportion of stained cotton as the result of planting the trees too close. He had shipped a small bale of lint which sold at 10*d*. per lb.

Mr. J. H. HART (Trinidad) stated that there should be about 50 acres of Sea Island cotton in Tobago. In Trinidad, the only variety of cotton that had been anything like satisfactory was the 'Sunflower' cotton, a superior grade of Upland cotton.

The PRESIDENT then retired to the meeting of the Education Committee. Professor HARRISON took the chair and asked Mr. THORNTON to present his paper.

Mr. T. THORNTON (Travelling Inspector in connexion with Cotton Investigations) read a brief summary of the progress of the Sea Island cotton industry in the West Indies. The acreage planted each year has increased, and side by side with the increase in acreage, the methods of cultivation and preparation of the cotton have become more sound. There has been a gradual improvement in the quality of the cotton produced, the plants have become acclimatized, until now the West Indies can successfully compete in Sea Island cotton production with any country capable of growing that variety. Cotton lands should be well prepared and drained, and the seed should not be planted immediately after preparation. As regards planting the seed, great improvements have been made, principally in the distances at which the seeds are sown apart. Over-crowding is now usually carefully guarded against, and machines for planting have been introduced and experimented with. The conservation of soil moisture and good drainage to prevent the soil at any time becoming sodden are matters that should receive every consideration, as they are correlated with much of the shedding of bolls that has been observed. Very few complaints are received from spinners as to the preparation of West Indian cotton. The quality of the cotton varies in the different islands. Cotton grown in the driest districts is short and of a coarse nature, but that obtained where the rainfall is greater is both longer and finer. Where the soil is very retentive of moisture and the rainfall high, the cotton produced has a tendency to become very weak and wasty. If the soil is very porous, although the rainfall may be high, the cotton does not suffer in this respect, as is seen in St. Vincent cotton. The quality of the various pickings is very important. In Barbados, two, and sometimes three, pickings have been obtained and samples of seed-cotton have been examined from individual plants from these pickings. The first pickin

cotton is always best, the second picking is shorter and coarser, but contains less weak fibre. The third picking, although long, is wasty, and contains an abundance of weak fibres.

The supply of seed for planting purposes has received careful attention by the Imperial Department of Agriculture. Only the seed from fields that had given the best results was used, and from this all poorly developed seeds, as well as other seeds known to give unsatisfactory classes of cotton, are carefully picked out by hand. Special plant selection experiments have been carried on throughout the islands, and results already obtained are of a very satisfactory nature. Varieties of cotton are being produced to suit the varied conditions of these islands. These are hardy, prolific, and capable of producing good qualities of cotton.

Sir DANIEL MORRIS returned and took the chair.

Mr. BALLOU (Entomologist on the staff of the Imperial Department of Agriculture) then read a paper on the treatment of cotton pests. It was stated that the pests of cotton were practically the same as in previous years, with the exception of the new pest in the flower buds of cotton at Antigua. In discussing the various remedies and the methods of their application in the treatment of cotton worm, Paris green and London purple were mentioned, and the ticklingburg bags, tin shakers, bellows, and powder guns were dealt with. A caution was given against the use of old manure or oat sacks in the application of the poisons.

The occurrence of the smaller cotton worm (*Aletia luridula*) in Barbados was mentioned, and it was stated that the remedies known to be successful for *Aletia argillacea* are sufficient for controlling the smaller cotton worm. The predaceous insects (*Calosoma* beetles and Jack Spaniards) which Mr. SANDS referred to as controlling the cotton worm in St. Vincent were discussed and it was stated that the good work of these insects was probably greatly helped by egg parasites which existed in these islands. An experiment in spraying cotton with lead arsenate, with different forms of spraying machines, was discussed, and it was stated that good results had been obtained.

The somewhat increased attacks of the boll worm (*Heliothis armiger*) and of the corn ear worm (*Laphygma frugiperda*) on the bolls of cotton were mentioned, and it was suggested that trap crops of corn would result in the protection of the cotton crops.

Cut worms, cotton stainers, aphis, and leaf-blister mite were mentioned, and the remedies that have proved useful in dealing with these pests were referred to. These remedies have all been discussed in previous publications of the Department.

In dealing with the red maggot of the cotton plant, Mr. BALLOU stated that up to the present time this pest had occurred in serious abundance only one year on any given field, and that during the past season it had not been reported as a serious pest.

The new pest of cotton reported by Dr. WATTS as occurring at Antigua in the flower buds, causing them to fall off prematurely, and thus resulting in the loss of a very large proportion of the bolls, was stated to be a small fly closely related to the red maggot.

The black scale of cotton (*Lecanium nigrum*) had been more serious in the past season. A native parasite had been discovered at Barbados which it was hoped would assist in its control. It was strongly pointed out that clean culture must be the beginning of all control measures in dealing with such pests as black scale, leaf-blister mite, and red maggot. These measures include the destruction of all old cotton as soon as possible after the crop is finished, and care in not planting cotton in the vicinity of any of the sources of infection.

Hon. FRANCIS WATTS drew attention to the fact that 'Jack Spaniards' had done considerable amount of good in St. Vincent, and asked Mr. BALLOU if he was able to state whether the insect there was a different species to that in the Northern Islands, where similar results had not been observed.

Mr. BALLOU stated that he had not, as yet, received or obtained satisfactory specimens of those insects known in the various islands as 'Jack Spaniards,' and it was suggested by the PRESIDENT that as complete a series as possible of these insects might be sent to Mr. BALLOU, and also that an interchange of specimens between the different islands might assist in satisfactorily answering the question raised.

Examination of specimens on hand in the Conference Hall showed that the 'Jack Spaniard' of St. Vincent was identical with the 'wild bee' of Barbados, which has given similar beneficial results.

Mr. SANDS (St. Vincent) confirmed the statement that the 'Jack Spaniard' had been of considerable service in controlling attacks of cotton worm at St. Vincent, but thought that the time had arrived when all cotton planters should have on hand a supply of insecticides. He also verified the similarity between the 'wild bee' of Barbados and the 'Jack Spaniard' of St. Vincent.

The PRESIDENT in summarizing the discussion referred to the necessity of taking all possible precautions to keep out the Mexican boll weevil from these islands, which he stated was a terrible pest of cotton in some areas of the United States, and was also doing damage in the island of Cuba. He said he believed this to be the most destructive pest that has been known to attack cotton, and referred to statements in respect to the amount of damage caused by this pest made by Dr. L. O. Howard, Chief of the Entomological Bureau of the United States Department of Agriculture, and reprinted in the *Agricultural News* (Vol. VI, p. 402). He also referred to the unadvisability of importing cotton seed for any purpose into these islands from Cuba, owing to the presence of this pest.

RICE INDUSTRY.

Professor HARRISON (British Guiana) referred to experiments that had been carried out at the Experimental Fields of British Guiana. The yields of different varieties were described, and the opinion was expressed that the varieties Nos. 6 and 4 (Ceylon Upland Rices) were very suitable for the local trade. No. 6 has given the highest mean yield of the varieties tested. Manurial plots show that increases of 4·7, 7·3, and 0·6 per cent. are due respectively, to the dressings with superphosphate, slag-phosphates, and basic superphosphates, presuming that the plots were of equal fertility when the experiments commenced. Trial was made in 1907 of a mode of planting singly carefully selected plants in the holes, in place of two or three plants as is usually done in the colony. The results showed that single plants in a hole gave better results than when two or three plants were allowed to a hole.

Hon. B. HOWELL JONES (British Guiana) referred to the great advance that the rice industry of British Guiana had made during the past few years. That colony now produces over 30,000 tons of rice annually, and during the year 1907, over 4,180,000 ℔. of rice were exported to other West Indian colonies and to French and Dutch Guiana.

Professor HARRISON then circulated some samples of rice that had been sent through the courtesy of the British Guiana Board of Agriculture to the Imperial Department of Agriculture.

Hon. W. FAWCETT (Jamaica) mentioned that rice cultivation was carried out on a very small scale by coolies at Jamaica. The original rice mills had gone out of operation for some time.

Mr. A. F. CLARK (Trinidad) stated that there were no statistics available as regards the area of rice cultivation at Trinidad. Rice was grown by East Indians for their own use in the Caroni district, and at San Fernando. The cultivation has been increasing gradually.

The PRESIDENT referred also to the cultivation of small areas of rice in the island of St. Lucia.

RUBBER INDUSTRY.

Mr. J. H. HART (Trinidad) gave a brief review of the position of the Rubber Industry of Trinidad and Tobago. Increase of acreage was taking place, and some gratifying results have been obtained. He also drew attention to a new rubber-producing plant in *Odontadenia speciosa*, a native plant of Trinidad belonging to the natural order *Apocynaceae*.

HON. W. GRAHAME LANG (Grenada) said that in 1906 he had imported 10,000 seeds of Para rubber from Ceylon packed in charcoal. About 80 per cent. germinated, and the plants appear to be quite promising.

Mr. J. C. MOORE (St. Lucia) mentioned the introduction of Para rubber into St. Lucia. He referred to the poor results obtained in the importation of plants in Wardian cases. He had obtained much better results by introducing Para rubber seeds from Ceylon packed in slightly damped charcoal.

The PRESIDENT said that he thought better results had been obtained in the transportation of rubber seeds in charcoal than by any other method. Importation by parcel post was advocated.

Hon. W. GRAHAME LANG stated that parcel post added to the expenses when large quantities were imported.

Mr. J. C. MOORE said that a second importation of Para seed in charcoal had given fairly satisfactory results. About 46 per cent. were raised.

Professor HARRISON (British Guiana) said that they had given up the importation of rubber seed from Ceylon, and they now got them direct from Singapore. Within the last few months he had imported 60,000 seeds, and had got nearly 82 per cent. germinating. These seeds cost on arrival about 1·2c. each, and the plants when put out had cost altogether 2·58c. each. They were packed in dry charcoal in seed-boxes and they were sent by parcel post to ensure the quickest delivery.

On Monday afternoon, Professor HARRISON gave an interesting account of the rubber-producing Sapiums from British Guiana. *Sapium Jenmani* exists in several parts of the colony on a fairly considerable scale, and some plantations are being started. An Experimental Rubber Station has been established, and several different kinds of rubber are being tried.

Hon. B. HOWELL JONES gave a brief description of the method adopted by the Government of British Guiana in giving grants of land in that colony for the extension of rubber, lime, and other industries.

AGRICULTURAL CREDIT AND LOAN BANKS.

Hon. F. J. CLARKE (Barbados) read a brief but interesting paper on the establishment and working of the Sugar Industry Agricultural Bank at Barbados. In 1886, an Act was passed, entitled an 'Act to enable sugar plantations to be cultivated and managed for a limited period' and generally known as the 'Plantations-in-Aid Act, 1886.' It provided for a government guarantee of advances against sugar crops of the following year. This Act never came into operation. In 1887, another attempt was made to solve the difficulty by the passing of the Agricultural Aids Act. This Act provided that owners may obtain advances on the security of their crops. This Act was brought into operation, and enabled planters to carry on with more or less difficulty according to the seasons, until the severe crisis in 1902. Strong representations were made to the Imperial Government, and

Barbados received £80,000 as their share of the free Grant of £250,000 to assist planters of the West Indies in tiding over the time that should elapse before the abolition of the bounties on beet sugar. This was not divided between sugar growers, but was used to enable the Government to make advances to them for the purpose of carrying on the cultivation of their plantations. To give effect to this decision an Act was passed, entitled the Plantations-in-Aid Act, 1902. The loans obtained under this Act were a specialty debt, the first lien against the plantation and against the crop and stock, and interest at the rate of 6 per cent. was charged on the loans.

The Act was renewed in 1903, and in 1904. In 1905, some slight changes were made in the Act; in 1906, it was renewed in the amended form. The Sugar Industry Agricultural Bank was started in 1907 for the purpose of continuing such advances to sugar producers as would have been obtained under previous Plantations-in-Aid Acts, in order to promote the collective and premanent interest of the sugar industry of the colony. Since the Bank was established it has lent £68,443 to ninety-three sugar producers. It suits the conditions surrounding the sugar industry of Barbados, and a career of usefulness and prosperity is predicted.

In the lengthy discussion that followed, in which the Hon. F. J. CLARKE, Mr. J. H. COLLENS, Professor CARMODY, Hon. FRANCIS WATTS, and the PRESIDENT took part, it was gathered that the Bank, although primarily intended for sugar planters, now allows that cultivators of other crops, such as cotton, etc., may receive loans from the Bank as long as they keep within the letter of the law by possessing on their estates some land in sugar-cane.

The Conference then adjourned until 10 a.m. on Monday, January 20.

GENERAL SUBJECTS.

Mr. G. ELLIOTT SEALY (Barbados), in an interesting address, drew attention to the want of a properly equipped Central Experiment Station for the furtherance of the agricultural interests of the West Indies.

It was the opinion of a great many people in Barbados that there was need for a station with a considerable area of land attached, and well equipped with laboratories, machinery, and necessary apparatus for carrying out experiments on a fairly large scale, and having a proper scientific staff attached thereto; where the treatment of plants of all kinds grown in any particular island could be clearly demonstrated to planters on the spot, and where research work of all kinds could be carried on. If an experiment station of that kind could be established and carried on at Barbados in addition to the valuable work which was at present being carried on by the Department of Agriculture, the value to the planters of the information obtained therefrom would be enormously increased.

The work at present was carried on in a scattered way. Mr. J. R. BOVELL (the present Agricultural Superintendent) lived at Codrington and his office was in Bridgetown. Dodds Botanic Station was in St. Phillips. A planter in need of information on a certain matter went to Mr. BOVELL, and he was referred to certain documents. These were very valuable, but that did not have the same effect on a practical planter as if he could go to an experiment station and see things for himself. The Committee of the Legislature, appointed to decide what should be done with the free grant of £80,000 which was made by the Imperial Government in aid of the sugar industry of the country, discussed the question as to whether it should not be devoted to the establishment of an Experiment Station, and very nearly recommended to the Governor that a portion of that money should be appropriated to the establishment of such a station in Barbados. They, however, did not make that recommendation. Nevertheless, he thought the opinion was stronger to-day than it was then that we should have an Experiment Station on the lines indicated.

Hon. F. J. CLARKE (Barbados), in supporting the proposition, said that at Dodds Botanic Station a large amount of work was carried out in investigations in connexion with the sugar-cane by Professor HARRISON and Mr. J. R. BOVELL. Having seen the valuable work done at Dodds, in 1891, a movement was put on foot to establish another and larger Experiment Station in the island. Sir DANIEL MORRIS happened to be at Barbados at the time and he strongly supported the proposal as one which would prove of immeasurable advantage to the sugar industry; and to which should be supported by the Government.

It was entirely owing to the work of such stations that beet had attained and still retained its present strong position, and he hoped that before long they would see a large station in Barbados where questions affecting the sugar and other industries might be taken up.

Mr. T. W. B. O'NEAL (Barbados) suggested the advisability of having two Experiment Stations--one in the red-soil district, and one in the black soil and non-ratooning district—because the results obtained at Dodds on non-ratooning soil did not always bear out those obtained on the red soil.

Professor HARRISON had no doubt that an Experiment Station such as that proposed by Mr. SEALY would be of the very highest value to planters. He suggested that a small committee might be appointed to thresh out the question and to report thereon.

Hon. W. FAWCETT (Jamaica) was also of opinion that a well-equipped Experiment Station would be of the greatest value in every colony; but he did not know whether in Barbados the proposal was to have a separate station independent of the Imperial Department, or whether there was to be a duplication of officers. Another question to be considered was that of expenditure.

Mr. SEALY explained that it was not his proposal that the Experiment Station should be separate and distinct from the Imperial Department, but that it should be an adjunct of the Imperial Department, so as to be able to take the place of that Department if the Imperial Government could not continue the vote for its continuance.

Hon. FRANCIS WATTS (Antigua) would not advocate anything in the shape of a model farm. What he thought was wanted was a Laboratory with sufficient area of land attached, where chemical, entomological, mycological, and geological work could be carried on easily and readily, and kept properly under control. In other words, his idea was, that there should be an extension of the laboratory into the field.

He did not advocate the carrying out of a big scheme in its entirety at the start, but the gradual acquirement of land attached to the Laboratory, where research work could be carried out.

Such an Experiment Station might be established, and it should in no sense be taken as displacing the local experiments that were at present being carried on in most of the islands, which should then be regarded as co-operative experiments, and which would create greater confidence in the results obtained. But he saw no prospect of such an Experiment Station in Barbados proving of more than distant use to a worker in Trinidad, Jamaica, or the Leeward Islands. Such stations should be localized. And here they were met with difficulties of expenditure of equipment, expenditure of officers, etc.

Yet he did not believe the difficulties to be insuperable, if they started with the idea of getting the land and laboratory together, and leaving the further development of the scheme to growth.

Hon. B. HOWELL JONES (British Guiana) mentioned that in British Guiana the land and laboratories were together, and there was hardly any necessity there for the establishment of a larger central station. Many proprietors had their own chemist who carried on experiments in the analyses of sugar and soils on the estates themselves.

Professor P. CARMODY (Trinidad) said that this matter had been raised in Trinidad, and one of the chief points which arose in connexion with it was the question of expenditure, which of course would have to be borne by the Governments. The cacao proprietors of Trinidad were willing to contribute to the expenditure necessary for establishing such a station.

The PRESIDENT, in bringing the discussion to a close, said that if the colonies were prepared to contribute funds for the establishment of extended experiment stations, he thought the circumstances would fully justify such a step being taken; and he would regard the taking of such a step in colonies like Barbados, the Leeward Islands, and Trinidad, as the natural growth of effort in those colonies towards attaining to a higher stage of agricultural development.

The PRESIDENT then appointed the Hon. F. J. CLARKE, (Chairman), Mr. SEALY, Mr. O'NEAL, Professor HARRISON, Hon. W. FAWCETT, Hon. FRANCIS WATTS, Hon. B. HOWELL JONES, Professor CARMODY, Mr. J. R. BOVELL, and Professor D'ALBUQUERQUE a Committee to consider the matter.

The Committee reported, in the afternoon session, that they recommended that it is of the highest importance to the progress of the agricultural industries of the West Indies and British Guiana that there should be one or more Central Agricultural Experiment Stations in each colony, that Advisory Boards of planters should be appointed in connexion with the work of these stations, and that the salaries of the scientific officers attached to them should be paid by contributions apportioned among the different colonies interested.

AGRICULTURAL EDUCATION.

The Committee appointed to enquire into educational matters presented their reports on Monday morning.

His Lordship THE BISHOP OF BARBADOS presented the report on Elementary Schools. From the reports to hand, which scarcely showed in sufficient detail the exact position of agricultural education in the different colonies, certain features common in all the colonies were noticeable. In every colony, steps have been taken in the training of elementary school teachers, though the details differ in the various colonies. The provision and use of school gardens have been general, and on the whole, the progress has been fairly satisfactory. There is general testimony to the fact that opposition on the part of the parents to their children working in garden plots has died out. Stimulus is also given to agriculture by the holding of agricultural shows, especially when provision is made for school exhibits. Model gardens have been established in British Guiana. In the smaller colonies, it is felt that one of the greatest wants is that of suitable direction to teachers and children and the people generally, by means of frequent visits of qualified Agricultural Instructors.

Revd. H. A. DALTON (Barbados) presented the report on agricultural education in Secondary Schools of the West Indies. It appears that in all the larger colonies, and in most of the smaller ones, serious and steadily growing efforts are being made to bring scientific agricultural instruction within the reach of those who aspire to become planters, or managers of plantations, or experts in tropical agriculture for the instruction of others. There is perhaps nowhere in the British Empire in which greater effort is made to make scientific education bear directly upon the special requirements and opportunities of the population among which it is given. This special direction has, without doubt, been largely stimulated by the work of the Imperial Department of

Agriculture; and as the power of the Department to assist it is gradually lessened by the diminution of the Imperial Grant, it is of the utmost importance that the Governments and the people of these colonies should show themselves willing to continue from their local resources the required assistance. In some colonies instruction in agricultural, as distinct from general science, is given in the secondary schools themselves. This method is perhaps most fully developed at Harrison College, Barbados. A second method is that used at Jamaica College where regular courses are held in general science. The third method has been adopted in certain smaller colonies, in which, if a Secondary School exists, no science is taught in it; and the method of establishment of Agricultural Schools has been adopted by the Imperial Department of Agriculture at Dominica, St. Lucia, and St. Vincent. A further method is in use at the Government Laboratory in Trinidad, by which persons may avail themselves of special agricultural instruction at nominal cost.

Revd. H. A. DALTON: I should like to offer a few observations supplementary to this report. First of all, I will say that a groundwork in elementary natural science should be regarded as a necessary and regular part of the curriculum in the education of all boys, because it is in the learning of natural science more than anything else, that a boy gets the great advantage of cultivating powers of observation by means of experiments, and by forming judgements and drawing inferences which he can easily understand. In doing his practical work, he has the advantage of seeing quickly the result of the operations in which he is engaged. I think in all we have to say and do about agricultural education in the West Indies, or anywhere else, we have got to bear in mind that it is absolutely necessary, in order to make anything out of it, that you should have for all students, whether they are going in for agriculture or not, this groundwork of general scientific education. When a boy has reached the age of sixteen or seventeen years, then comes the time when he should specialize, and that specialization should be guided and determined by the circumstances in which the boy is likely to find himself. Agriculture is the main industry of these West Indian colonies—I do not think it is likely for us to become any great manufacturing centre—and therefore, as far as the West Indian boy is concerned, we should devote our energies specially to teaching agriculture rather than mechanics and electrical engineering. Agriculture like everything else depends upon science, and there is no agricultural work which can be carried out properly without a knowledge of the principles of science which underlie it, and which are essential to its effective working. The agriculturist ought to learn and understand that the process of nature must be directed by a knowledge of nature, and, as Lord Bacon said many years ago, 'Nature can only be controlled by obeying her.' The conviction of the need of scientific knowledge in agricultural processes has been largely fostered in these colonies by the Imperial Department of Agriculture. I want the Conference to recognize particularly in this matter of agri-

cultural education, that at this present moment we are standing at the parting of the ways; we are in a crisis and we have got to deal with that crisis. The Imperial Department is obliged gradually to diminish its financial aid, and we do not know what is going to happen in the future, and therefore at this particular moment, it should be brought out as strongly as possible and insisted on, that if this work is useful and if it is to be continued—if it is to prosper—it rests with the Governments of the various colonies to continue it. I am perfectly aware that in some of the larger colonies especially, the Governments do a great deal and have always done a great deal. In other colonies, that is not quite the case; but it is most important that we should take every opportunity of impressing upon the Governments the importance of giving the utmost aid that is possible in every colony to this work of education in natural science. Education generally is now recognized all through the world as a public work; and if that is the case with general education, still more should it be the case with education in natural science, for the simple reason that it is the most expensive of all kinds of education. It should receive full assistance from the Governments because it is directly essential and necessary to the material prosperity of the colonies administered by the Governments. I should like to emphazise that the exhibitions which enable promising boys to attend the schools where agricultural science is taught should be maintained. Scientific instruction cannot be given by a teacher unless he has the money to provide the necessary apparatus; it must be given in a school where the organization is proper and thorough. Of course, it is not possible to insist on having one particular method throughout the West Indies: each colony has its own particular method; but let us all have the one united idea—that we are going to make instruction in agricultural science as systematic, persevering, and effective as it can possibly be. And it cannot be fully effective without our universities, because there is no doubt that university education is the crown of all other education. I do not suppose that a university for the whole of the West Indies will ever exist; I do not think that such an institution is really needed; there are plenty of them in New York and Canada and in England. But I think it is worth while, for the sake of boys whose parents can afford the extra course of instruction, to bring to the notice of members of this Conference that at Cambridge there is now a regularly formed school of agriculture. I do not know anything about the details, but I believe that it is doing exceedingly good work, and I cannot imagine anything better for the West Indian boy whose parents are in a position to give him that kind of education after he has passed through the agricultural work in the schools of the West Indies, than to go to Cambridge, having already got his foundation properly laid, to get the full advantage of what he can obtain there. It is our business to do all we can to make this agricultural work as good as it can be, under the conviction that, provided we make the education really good, the better it is, the better it will be appreciated.

Hon. Francis Watts in an able address brought forward the necessity of instituting a system of scientific and practical instruction of overseers, and sub-managers of estates for an examination for certificates on the theory and practice of Agriculture. Courses of reading suitable for young men anxious to extend their knowledge of matters relating to tropical agriculture should be established. They should have special reference to the methods of cultivation of local crops. Examinations should be held at regular intervals and candidates might, if they wished it, be examined in a single branch of knowledge only. It is suggested that no one should be allowed to sit for examination unless he has been engaged in the actual practice of his work for at least one year, in order that it may be assured that he should be thoroughly qualified in the practical cultivation of the crops specified on his certificate of proficiency. He referred to how diplomas or certificates of proficiency might be of value in the guidance of owners and attorneys of plantations towards the choice of men for junior posts. He also mentioned that all examinations should be as practical as possible and that the board of examiners should contain at least one or two practical planters.

An interesting discussion followed, and many of the difficulties in the way of such a system were brought forward.

It was suggested that the subject should be brought up for discussion at the various Agricultural Societies in the West Indies, in order that the planters and overseers might be made acquainted with the proposals. The system of examination adopted by the Board of Agriculture and the Royal Agricultural Society in Great Britain for the National Diploma in Agriculture was instanced as being something like what was desired to be commenced in the West Indies.

Professor Carmody stated that in Trinidad, the London Board of Commerce issued certificates of proficiency in various trades, and the President referred to the examination for young gardeners carried on by the Royal Horticultural Society.

GENERAL SUBJECTS. (*Concluded.*)

In the afternoon session on Monday, the Committee on tobacco reported that the services of an expert would be useful in St. Kitt's and possibly also in St. Lucia, but in the rest of the Windward and Leeward Islands and in Barbados, so much attention is being given to cotton that there is no hope at present of tobacco being taken up. It would be possible to get two of the apprentices from the Jamaica Gardens to give instructions for six months, at a moderate cost.

Hon. Francis Watts read an interesting paper on some Essential Oils. The erection of a small still at the Botanic Station, Antigua, had been the means whereby a certain amount of information has been collected concerning a few essential oils—including lemon grass, bay leaf, and camphor oils. The

information available is yet of a preliminary character, but answers many questions that are frequently asked in connexion with these oils. A still suitable for making essential oils was briefly described.

Professor J. P. D'ALBUQUERQUE gave information in respect to some samples of Cochin lemon grass oil that had been made at the Government Laboratory, Barbados, which suggested that care would have to be taken in the time of cutting the grass, before submitting it to distillation. Over-ripe grass should not be expected to give the same yield as grass cut at the proper time.

Hon. FRANCIS WATTS followed with a brief account of experiments with broom corn, and stated that he thought that this was a crop that might recommend itself as a rotation crop in many of the West India Islands and for use as green manure. Specimens of dried broom corn were submitted for examination to the representatives of the Conference.

Mr. W. W FROGGATT (Government Entomologist, New South Wales) is travelling for the New South Wales Government for the purpose of enquiring into the work of parasites as a control for insect pests He stated that he had visited many parts of the world, and referred to the satisfactory work done in control of the leaf-hopper on sugar-cane in Hawaii. He particularly emphasized the non-success of the control of the Fruit Fly in California by means of parasites, although reports from that State mention that some success has been attained. The evidence given by Mr. FROGGATT to the Conference was of great value and interest.

The PRESIDENT thanked Mr. FROGGATT for his interesting address and referred to some of the efforts that had been made by the Imperial Department in the question of the introduction of parasitic enemies of insect pests.

After dealing with a few other special subjects, the PRESIDENT announced that this brought the proceedings of the Conference to a conclusion.

EXCURSIONS.

The, Reception Committee appointed by the Barbados Agricultural Society and the Chamber of Commerce organized three very interesting excursions for the representatives to the Agricultural and Canadian Conferences. These were the excursions on January 16, 17, and 19. By means of these excursions the representatives were enabled to obtain a good idea of the methods of cultivation adopted by Barbados planters in respect to sugar-cane, cotton, etc., of the improvements that are being made in some of the sugar factories of the island, and of the working of the Barbados Sea Island Cotton Factory.

The excursion to Bathsheba and country districts on Thursday, January 16, was by special train. Stops were

made at Bulkeley Sugar Factory, where the representatives and members of the Reception Committee, together with a number of ladies, were shown over by Mr. DOUGLAS PILE; at Carrington Sugar Factory, where they were received by Mr. H. BOVELL, the Manager of Carrington estate; at College Siding from whence the visitors were taken to Codrington College, where they were received by the Very Revd. ARCHDEACON BINDLEY. After leaving the College, the representatives were taken to Bathsheba to luncheon, and afterwards proceeded to Belleplaine, where Professor HARRISON delivered a brief but very interesting account of the geological formation of the portions of the island through which they had journeyed.

On Friday, January 17, an afternoon visit was made to the Barbados Co-operative Sea Island Cotton Factory, the representatives being shown over by Mr. INNISS (Manager), the Hon. F. J. CLARKE, and Mr. J. R. BOVELL. This factory commenced work in the new buildings on January 1907. It contains twenty-four gins, hydraulic baling press, and seed disintegrator. It is the largest Sea Island Cotton Factory at present in existence. The factory was full at work and the visitors were intensely interested, especially those who are intimately connected with the cotton industries and the working of cotton factories in the other West India Islands.

On Sunday, January 19, a number of representatives were taken to the Crane by motor bus and in carriages. This afforded an opportunity of passing through some of the lands the best suited for cotton in the island, and many points in connexion with the Barbados methods of cultivation, etc, were brought up for discussion.

EXHIBITS.

Several of the members of the Conference submitted a fairly large number of interesting exhibits. A considerable number of samples of Sea Island cotton, arranged in boxes with glass faces were exhibited by Mr. J. R. BOVELL, Agricultural Superintendent, Barbados; Mr. W. N. SANDS, Agricultural Superintendent, St. Vincent; and Mr. F. R. SHEPHERD, Agricultural Superintendent, St. Kitt's. Many of these samples were from the best cottons produced by the respective islands, and interesting comparisons were made with a view to obtaining information as to the various qualities of the different exhibits. Pods of different varieties of cacao were brought from Trinidad by Mr. J. H. HART, and the Hon. W. GRAHAME LANG exhibited a considerable number of samples of cured cacao from Grenada.

Exhibits of several of the best varieties of seedling and other canes from Barbados were brought by Mr. BOVELL, and were of considerable interest to those of the representatives directly connected with the sugar industry of these islands. Other specimens of canes were brought by Professor HARRISON and Mr. F. R. SHEPHERD. Interesting exhibits of B. 208 from

the Botanic Gardens, British Guiana, and of a striped variety of that cane from St. Kitt's were also shown. Specimens of root disease were submitted by Mr. BOVELL and Mr. STOCKDALE, and the beneficial effect of soaking cane cuttings in Bordeaux mixture was clearly indicated by exhibits shown by Mr. BOVELL.

Samples of Demerara grown rice were exhibited, through the courtesy of the Board of Agriculture, British Guiana, by the Imperial Department of Agriculture, and representative exhibits of specimens of a large number of the insects and fungi of economic importance in the West Indies were made by Mr. H. A. BALLOU and Mr. F. A. STOCKDALE respectively.

CONFERENCE DINNER.

The members of the West Indian Agricultural Conference and the Canadian Conference dined together at the Marine Hotel on the evening of Saturday, January 18, at 8 o'clock. The arrangements of the dinner were in the hands of a Committee, consisting of the Hon. B. HOWELL JONES, the Hon. FRANCIS WATTS, and Mr. J. R. WILLIAMS, appointed for the purpose.

The President of the Agricultural Conference (Sir DANIEL MORRIS) occupied the Chair. Covers were laid for seventy-eight. In addition to the members of the two Conferences, there were a number of guests including the following: Lord BASIL BLACKWOOD (Colonial Secretary); Mr. OTHO CARTER (A.D.C. and Private Secretary); Lieut-Col. A. B. R. KAYE, (Inspector General of Police); Mr. C. P. CLARKE (Solicitor General); Mr. G. DE LABASTIDE; etc., etc.

His Excellency the GOVERNOR (Sir GILBERT T. CARTER) and his Honour the CHIEF JUSTICE (Sir HERBERT GREAVES) were unavoidably absent.

Dinner over,

Sir DANIEL MORRIS rose and proposed the toast of 'The King,' which was drunk with the accustomed honours.

Sir DANIEL MORRIS again rose and said: I have to express on behalf of his Excellency the Governor his great regret that he is unable to be with us this evening, owing to indisposition. In the absence of his Excellency, his Lordship the Bishop has been kind enough to take charge of the toast of 'The Imperial Department of Agriculture.'

His Lordship the BISHOP thereupon rose and said: Sir DANIEL MORRIS and Gentlemen,—It seems to me that every Agricultural Conference is likely to bring to me a new experience. Last year, as you remember, we had a dreadful experience in Jamaica, the like of which I had never experienced before, and now to-night, another experience has been put upon

me. I should like to have had a little more notice given that I was to propose this toast, because it is the toast of the evening, namely 'The Imperial Department of Agriculture.' I think Mr. Chamberlain never did a better or wiser thing in the interest of the West Indies, than when he instituted this Agricultural Department. (Cheers.) In going through education reports from the other colonies and particularly those over which the Agricultural Department exercises influence, we find that in every colony there has been some attempt more or less in educating the teachers and children in agriculture: school gardens have been formed and agricultural colleges established. The fruits of these efforts cannot be seen now, but will in the near future. The Department of Agriculture has had a great many difficulties to contend with : some of these it has got over. There is one thing that we the members of the Education Section have found out and that is, that whatever may be the failure in the case of school gardens or anything like that, it is not owing to any want of attention or effort on the part of the Department, but to want of appreciation on the part of the local Governments who have not supported the efforts of the Department as we think they ought to have done; and I think we shall emphasize that in our report. The success of bringing all these delegates together to-night from the various islands, making them forget their insularity, and meeting for one purpose alone, and that is, the good of West Indian Agriculture, speaks for itself. It is an example of the success of the methods of the illustrious head of the Imperial Department of Agriculture. I mentioned at a meeting of the Education Committee a plan I had in my mind—I call it a dream of an old man, perhaps only to be laughed at having regard to further advance in agricultural instruction. I should like to see, and to live long enough to have some hand in bringing about, the establishment of a college which would embrace all the islands of the West Indies, and that there should be in it a faculty of tropical agriculture. (Hear, hear.) I have advocated the claims of the Imperial Department of Agriculture very badly indeed, but I have done as well as I could at very short notice and I ask you, gentlemen, to join with me in wishing success to the Imperial Department of Agriculture, and long life to its Commissioner, Sir DANIEL MORRIS.

The toast was drunk with much enthusiasm.

Sir DANIEL MORRIS (who on rising to respond was greeted with cheers) said : My Lords and Gentlemen,—I feel exceedingly indebted to his Lordship the BISHOP for his kindness in coming here and undertaking the duty of proposing the toast of the Imperial Department of Agriculture. His Lordship has been one of the most steadfast friends of the Department, especially in regard to the question of agricultural education. This is the second occasion on which his Lordship has acted as Chairman of the Education Section. The Education Section at this Conference has done valuable work in bringing together a record of the efforts that have been made in

different parts of the West Indies to encourage the teaching of agriculture in elementary schools. This record it is proposed to submit to the Secretary of State. The Conference of 1908 will, I believe, be a memorable one. To begin with, we have a larger number of representatives on this occasion than at any other Agricultural Conference. We have also a Conference with regard to Trade Relations with Canada. The meeting of these two Conferences will stand in history as possibly the first stage of a common Legislature for the whole of the West Indies. I believe that when such a time comes, the West Indies will begin to assume their real position among the agricultural communities of the world. At present, the West Indies are so isolated and divided that they can hardly take joint action on any single subject. Perhaps that is not the fault of the West Indies; it may be the fault of their circumstances, geographical or otherwise. We have on the present occasion Administrators, Colonial Secretaries, and members of Executive and Legislative Councils. We have practically what may be called a West Indian Parliament. To attain success in our present efforts we must have a long pull and a strong pull to make the West Indies still more prosperous. They have had a splendid history, and I do not despair of seeing them attain to considerable prosperity in the future. (Cheers.)

We have in the Canadian Conference now meeting here an agency that may bring us into closer contact with our vigorous and thriving kinsfolk to the north. If, as the result of the Canadian Conference, we can convince the people of the Dominion that we are prepared to meet them half way, they will no doubt respond and make such changes as regards transportation or other matters as will be of great advantage to both countries.

To return to the Agricultural Conference; I have been very much struck on the present occasion with the thoroughness and heartiness with which all the representatives have joined in the business of the Conference. We have had fewer set papers than before, but we have had more interesting discussions, and I hope when the records of the Conference are published they will be found to contain subjects of great value and interest. The West Indies are fortunate in the character of the men entrusted with agricultural work. They are men of high standing in science, and are as competent as any in other parts of the world. In addition, we have well-trained technical men who have become closely associated with their work and in entire sympathy with the people among whom they labour. We have also members of Agricultural Societies attending our Conferences, and I believe the blending of the labours of the scientific and practical workers will secure the best results from both sides. The scientific officers of the Department have done their work in such an excellent manner as to gain the confidence of all those among whom they labour.

The Department has now been working for some years. In March 1908, the Department will have existed for nine and a half years. That will be the end of the first term of its

existence. From April 1, the Department will enter upon its second term, which will last from April 1, 1908, to March 31, 1913. The Department will be maintained partly from funds supplied by the Imperial Government and partly from colonial funds. I am happy to say that practically all the Legislatures in the West Indies have consented during the coming year to make up any deficiency that may arise in the Imperial grant. (Cheers.)

This proves that the Imperial Department of Agriculture is regarded as essential to the welfare of the West Indies. I rejoice in the prospect that the Imperial Department of Agriculture will be continued for another period of five years on the present lines. (Renewed Cheers.)

Hon. FORSTER M. ALLEYNE (Barbados): I have had a great honour conferred on me this evening; that is, I have been asked to propose a toast to the visitors to this island, whom we have been doing our best to entertain during the past week. You may have thought that we, who have taken part in your excursions, have been chiefly the measure of affording you the gratification you have had. That is not the case. All the gratification and entertainment have been the spontaneous gift of the whole island. (Cheers.) It is from the people of Barbados. It is their gift and is not the gift of any particular individual. I feel very grateful to our friends who have come from Canada. We offer and extend to them a most hearty reception, and we hope that their efforts may enable us to obtain *rapproachment* between Canada and the West Indies that will be of lasting benefit to all. (Cheers.) Now we come to the objects of the Agricultural Conference. Of course we have met here together to compare notes as to our experiences and to do our best towards the promotion and improvement of the industries we all have at heart, whether it be sugar-cane, rice, cotton, limes, or anything else. But there is something else that exists beyond that. We have come together very often. What we want, and what these Conferences are helping us to do, and what every time we meet I feel more sure of, is that we want here in the West Indies not so much a federation of governments as co-operation of our aims and objects. (Cheers.) We must never forget that we owe all these Conferences to Sir Daniel Morris; it is through him that has come about all the practical suggestions that the Royal Commission of 1897 made; and it is to him that all the success that attends these annual gatherings is due. When I spoke at the last Conference in Trinidad I said I was afraid it was hardly worth while asking the people of Trinidad to come over to Barbados, because we had so little to show them either in the way of scenery or machinery. That was true then and it remains true now. But we have made a start.

I must ask you to drink to the health of the visitors to Barbados, coupling with the toast the names of the Hon. R. H. MCCARTHY, Mr. WILLIAMS, and the Hon. E. ST. JOHN BRANCH. (Applause.)

The toast was drunk with the utmost enthusiasm.

Hon. R. H. McCarthy (Trinidad), in replying, said: I endured a good deal of mental distress about an hour before we sat down to dinner, when a member of the energetic Committee of this banquet informed me that I had the task of replying, or partially replying, to the toast of the visitors. To make a speech worthy of an occasion like this in an audience so large and important would, in my case, require that one should have about a week to think about it. This is the third occasion on which I have been selected officially to attend conferences at Barbados, and I look on each of those occasions with a certain amount of pride. The present occasion is a momentous one, for here are gathered together the members of two Conferences—one performing the task of convincing and proving to the West Indians that advance in agriculture can be made, while the other, with which I am more closely associated, is endeavouring to effect improved trade relations between these colonies and that large colony Canada. Barbados, in spite of the modest tones in which Mr. Forster Alleyne spoke, has a great deal to be proud of, and knows it (cheers)—a long and proud history to which we from the other islands must take off our hats. Destiny has something better in store for Barbados. I am convinced that here one day, some day—whether it be near or far depends upon the people of the West Indies and to a great extent upon the people of Barbados—representatives from all the West Indies will assemble here and will guide these West Indies to prosperity and to progress, and will take a share in the affairs of the Empire by sending their representatives to Westminster. That may be a dream, but it is a dream that will be realized one day, and if I were a Barbadian, or a West Indian even—I am only a bird of passage, a stranger and sojourner—I should look forward to that day as a great day in our history. (Applause.)

Mr. J. R. Williams (Jamaica): Every member to these Conferences, a visitor to Barbados, is, no doubt, anxious to express personally his appreciation and gratitude to the people of Barbados for the hospitality and entertainment they have shown us, and for the infinite trouble which we know they have taken on our behalf. I first came to Barbados when I was very young. Before I came here I knew it was a small island—I mean small in comparison with Australia or Japan—but during the days we have been here, there has been much more a chance of Barbados exhausting us than of our exhausting Barbados. The only other fact that I knew about it was that it had a crowded population, and it is one of the most beautiful examples of one of the scientific verities that where everything has become crowded we should suit ourselves to our environment. Here everything has been crowded: our business has been crowded and pleasure has followed so close upon business that it is impossible to say where the one ended and the other began. We have learnt all sorts of lessons—agricultural, scientific, and reciprocal. There is, however, one lesson which is very interesting, and that is the way they deal

with a superabundant population. It is interesting to delegates coming from afar. We have learnt how to make the best of everything and that is what all of us can learn with advantage. As this evening grows older, there seems to be a feeling of being drawn closer to one another. That, I think, means that we are fast being tuned up to concert pitch in the matter of reciprocity, and it indicates that both our Conferences must and will be exceedingly successful. (Applause.)

Hon. E. St. John Branch (Leeward Islands) said: The replies to this toast are three-fold, and you will forgive me if I merely content myself with associating myself with all that has been so ably said by my two friends who preceded in responding to the very kind words of Mr. Alleyne, and with re-echoing what we have experienced in the kindly welcome that has been accorded to us since we have come to Barbados. (Cheers.)

Professor P. Carmody (Trinidad) said: The task which has fallen to me to-night is a very agreeable one, but at the same time it is exceedingly difficult, because whatever words may pass from my lips and however I may try to express them, I feel that anything I may say or however well I may say it will be inadequate for the occasion, because, as you have heard from Mr. Forster Alleyne, the hospitality that has been given on this occasion to the visitors to this Conference has been the whole-hearted, spontaneous hospitality of the whole of the people of this island. Barbados, from its geographical position stands above all the other West Indian colonies, and so likewise in regard to hospitality it stands head and shoulders above all these colonies. It is impossible for me to describe the experience which we have had of that hospitality. We have received attention which makes us feel that each one of us was a special object around which the Reception Committee gathered, and I think they deserve unlimited credit for the way in which they have undertaken the work they have done to render the visitors comfortable. I now ask you, gentlemen, to rise and drink the health of the Reception Committee, coupling with the toast the name of the Hon. Mr. Clarke. (Cheers.)

The toast was drunk with greatest enthusiasm.

Hon. F. J. Clarke (Barbados), in responding, said: On behalf of the members of the Reception Committee and the people of Barbados, I most heartily thank Professor Carmody for the kind words that he has said to us, and you, gentlemen, for the hearty way in which you have received what he has been pleased to say. We feel that we are rewarded by this kind appreciation of our efforts to welcome and entertain you as guests in this island and to make your stay as pleasant as possible. I assure you that it has been the greatest possible pleasure to us to do all in our power to make you happy. When we came to plan our entertainment we found ourselves in difficulty. There were some of us who had been to Trinidad and others to Jamaica, and we felt that it would be almost impossible for us to attempt to compete with those two colonies. We have no fine

scenery, we have no wild interesting country, we have no natural phenomena, and when we planned one or two excursions, we found ourselves at the end of our tether. But if we have been able to do anything to make your stay in this island agreeable, we feel that we have been amply rewarded. There is one side of these Conferences which should not be lost sight of, and that is the social side. When men from different colonies with different interests meet together, they interchange views, receive each other's hospitality, and get to think better of each other. They lose prejudices, and also learn that to accomplish anything we must all work cordially together. (Cheers.)

Hon. FRANCIS WATTS (Antigua), in proposing the toast of the Agricultural Boards and Societies, said: This Conference this evening I may characterize as one of dreams—dreams of things which are to happen -dreams of things which some of us, perhaps all of us, hope may come to pass. May I say that it is in the Agricultural Societies that these dreams begin and must end and have their fulfilment. These Agricultural Societies and Agricultural Boards have a great work to do and a great mission before them, and must necessarily play a great part in the work we have in hand. It is in the medium of the Agricultural Societies and in Agricultural Boards that good seed is planted, in which the seed will germinate, grow, and we hope, come into fruit. It is there that the ideas formulated in other places are put to the touchstone of practical utility. There they are carefully tested by those whose business it is to hand them on and make them things of everyday life and everyday work I ask you, gentlemen, to rise and drink to the toast of the Agricultural Boards and Societies, coupling with it the name of Mr. EDGAR TRIPP. (Cheers.)

The toast was drunk with enthusiasm.

Mr. EDGAR TRIPP (Trinidad) briefly replied in an interesting speech, stating how he became connected with the working of Agricultural Societies.

The party separated after singing the National Anthem.

CONCLUSION.

The PRESIDENT on Monday afternoon stated that in closing the Conference, he wished to place on record his best thanks for the kind and cordial manner in which all the representatives had assisted in making the Conference of 1908 a success. A large amount of work had been got through. The question of seedling canes had been fully discussed. Larger areas, estimated at 50,000 acres, were now planted, and it is confidently hoped that seedling canes will give such results in points of yield and resistance to disease as will recommend them for general adoption. In cacao, we had a fine quality in the West Indies. Efforts should, however, be made to get the product more uniform. A large amount of knowledge has been obtained of the diseases of cacao,

and the cultivation should receive much more attention if the cacao industry of the West Indies is to advance and prosper. Cacao in Grenada was increasing in area, but the exports had not advanced at a proportional rate. Grenada has to depend upon practically a single industry; therefore every effort should be made to keep the trees in health and capable of yielding remunerative crops. The lime juice industry was making satisfactory progress. The cotton industry is now fully established and it contributes very largely to the welfare of many of these colonies. The rice industry was advancing rapidly in British Guiana, while the rubber industry is likely to be an important one in the future of British Guiana, Trinidad, and Jamaica.

In concluding, Sir DANIEL MORRIS mentioned that the members of the Conference were greatly indebted to the Government of Barbados, to the General Assembly, and to the Reception Committee appointed by the Agricultural Society and the Chamber of Commerce for the very excellent arrangements they had made. It was incumbent upon them also to express their indebtedness to the Royal Mail Steamship Company for the liberal treatment that representatives had received from them. Thanks are also due to the Manager of the Barbados Light Railway, the Managers of the Motor bus and Tramcar Companies, the Inspector General of Police and others who had so largely contributed to the success of the Conference arrangements.

Hon. FORSTER M. ALLEYNE, in moving a vote of thanks to the PRESIDENT, said that at the opening of the Conference he foretold that it would be a successful one. If this had been a successful Conference, it was in a great measure due to the tact, perseverance, and ability with which the PRESIDENT had conducted their deliberations. A great many subjects had been brought up for discussion; some of them may have been thorny, but they had got through the work in a most harmonious way, and they had all profited by the experience of one another, not only from the papers which had been read, but by the discussions that had subsequently taken place. From a social point of view the Conference had also been a success, and he was glad to hear the way in which the PRESIDENT had spoken of those who had been instrumental in helping them to carry out the arrangements. The time, however, had come to say good-bye. They could all of them say that they had had a useful time, and a happy time, and he hoped everyone would carry away with them pleasant recollections of the Conference at Barbados of 1908. (Applause.)

Hon. E. G. BENNETT, in seconding, said he was present as a visitor, but not as a representative, at the first Conference held in Barbados and had since followed the work of the Department very carefully. He was convinced of the importance of that work and of the value of the indefatigable efforts of Sir DANIEL MORRIS in raising the fortunes of the West Indies, not only in the direction of agriculture but in drawing the attention of outsiders to the resources of the West Indies, and in attracting capital and desirable settlers for the development of those resources.

Hon. FRANCIS WATTS, in supporting the vote of thanks to the PRESIDENT, put it to the meeting and it was unanimously carried, the members of the Conference signifying their assent by all standing.

The PRESIDENT, in acknowledging the vote of thanks, desired to assure members of the Conference that he would look back upon this Conference as the best of the many over which he had presided.

Hon. B. HOWELL JONES, on behalf of the delegates, formally proposed a vote of thanks to Mr. BOVELL and his assistants for the admirable manner in which the arrangements for the reception and entertainment of the delegates had been carried out.

Hon. FRANCIS WATTS seconded the vote of thanks, which passed unanimously.

Mr. J. R. BOVELL, in tendering his thanks for their kind references to him in connexion with the arrangements for the excursions, said it would have been impossible for those arrangements to have been successful without the ready help that he had received from the Chairman (Hon. F. J. CLARKE) and other members of the Reception Committee, and from the clerks in his office, especially Messrs. C. E. STOUTE and J. H. DASH. They had had the magnificent standards of Jamaica and Trinidad before them and they had attempted to do their best for the delegates in order that they might, in some measure, return the hospitality received in those colonies.

Professor CARMODY then moved a vote of thanks to the Honorary Secretaries of the Conference (Messrs. A. G. HOWELL and F. A. STOCKDALE) for the excellent manner in which they had discharged their duties—duties which had contributed to the smoothness with which the machinery of the Conference had been run.

The vote of thanks was carried.

The PRESIDENT was glad that Mr. CARMODY had not forgotten the services of the Secretaries and that they had been acknowledged by the Conference. He added that, owing to the effort of Mr. STOCKDALE, it was hoped that sometime to-morrow, they would have placed in their hands a special Conference number of the *West Indian Bulletin* containing a summary of the business of this Conference up to this afternoon. (Applause.)

The PRESIDENT then declared the Conference closed.

REPORT OF THE COMMITTEE ON AGRICULTURAL EDUCATION IN THE WEST INDIES.

ELEMENTARY SCHOOLS.

The Education Committee have carefully considered the reports which have been presented by the several colonies dealing with agricultural elementary education.

The reports, which were true as to facts, scarcely showed in sufficient detail the exact position of agricultural education in the different colonies, and the Committee suggest that it would be well that they should be referred back to the different colonies for more detailed and complete information.

The Committee recommend that, in referring the several sections of the report to each of the colonies concerned, information should be particularly asked for under the following heads:—

(1) The average size of the class for practical agriculture and the average size of the plot.

(2) What standards are included in the class?

(3) Within what limits are the children who take part in practical work confined?

(4) Is any provision made for the special remuneration of teaching practical agricultural work, and if so, what?

(5) What place in the school time-table does practical work in agriculture occupy?

(6) What provision is made for instruction of teachers and students in Training Colleges to qualify for such special work?

(7) What provision is made for meeting the expenses connected with (*a*) fencing, (*b*) tools, etc., and (*c*) seeds necessary for school gardens?

(8) What special difficulties are there in your colony in the establishment and maintenance of school gardens?

(9) Is agricultural instruction compulsory?

We find, however, from the reports at hand, that there are certain features common to all the colonies.

TRAINING OF TEACHERS.

In nearly every colony steps have been taken towards the training of elementary school teachers, though the details differ in the various colonies.

In Jamaica, for example, a continuous course of lectures for a month at a time has been given for several years. Teachers from the country have been brought down to the Mico Training College, where they have been maintained at the expense of the Government. The services of the staff of the Mico College have been utilized, supplemented by the officers of the Government Laboratory and Botanical Departments and volunteer lecturers.

The annual cost of the monthly training has been about £175, and nearly all the head and assistant teachers of elementary schools have been through the course.

Similar courses of lectures have been given at one or more centres in each of the other colonies. In some instances assistance—to a greater or less extent has been given by the Government of the colony. In others, the total expense has been defrayed by the Imperial Department of Agriculture.

The result has been that all the elementary teachers of the several colonies have had an opportunity of instruction in agriculture, and a large proportion have availed themselves of it.

In addition to instruction given to teachers who are already engaged in teaching, the reports show that agriculture forms a regular part of the curriculum for male students in the Training Colleges in Jamaica and Trinidad, and for female students at the Spring Garden Training College in Antigua.

SCHOOL GARDENS.

The provision and use of school gardens have been general, and, on the whole, the progress has been fairly satisfactory. Where the progress has been less satisfactory it has been due in part, to the difficulty of obtaining land, as in Barbados, or to the cost of preparing it, as in British Guiana, but more to the smallness of the grant allowed to elementary teachers for agriculture.

There is no indication that teachers are now unwilling to teach the subject in any of the colonies. But in some, as in Barbados, it pays them better to teach other subjects. Where real success has been attained, as in Trinidad, it has been due to the liberal scale on which grants have been allowed for teaching the subject.

There is general testimony to the fact that the opposition on the part of the parents to their children working in garden plots has died out, and there is no less common a belief on the part of the members of the Committee, that if grants for teaching the subject were more liberal in certain colonies, there would be no complaint as to the lack of interest on the part of the teachers.

Where it is impossible to obtain land for school gardens, the children in many schools cultivate plants in pots and boxes at school and at home.

AGRICULTURAL SHOWS.

The testimony is general, as to the stimulus which is given to agriculture by the holding of agricultural shows, and especially so when provision is made for school exhibits. In Barbados, last year, no less than fifty-one prizes were gained by school exhibits. Such shows have great interest for the parents, and must influence for good not only the children themselves but all who are connected with them. For these

reasons the Committee suggest that the holding of such shows with prizes to school exhibits should be extended as widely as possible.

MODEL GARDENS.

An interesting account has been given of the model gardens which have been established in British Guiana—two in Georgetown and three in the country districts. These appear to be excellent centres for teaching the children and others in their neighbourhood, and we specially commend a practice which there obtains of giving to four selected boys, the opportunity of continuing their agricultural education by apprenticeship to the scientific instructor of the Government.

In the smaller colonies, it is felt that one of the greatest wants is that of suitable direction to teachers and children and the people generally, by means of frequent visits of qualified Agricultural Instructors.

All the representatives on the Committee wish to emphasize the vast importance of this subject of education in Agriculture to the welfare of every colony, and all bear testimony to the marked advance, not only in knowledge of, but in general interest in, agricultural matters. This is true not only of children but of parents and others generally. The opposition of parents, the indifference of teachers, and the ignorant attitude assumed by some that scientific instruction was not needed have passed away, and considering the difficulties such as these combined with the smallness of the financial grants, the Committee considers the past satisfactory and the future full of hope.

SECONDARY SCHOOLS.

The Educational Committee have had under review a series of reports dealing with agricultural instruction given in the West Indian Colonies to students other than the pupils in elementary schools. The reports have been drawn up at the Head Office of the Imperial Department of Agriculture from the printed matter there available. The sketch given is, however, necessarily incomplete. It is understood that before they are put in their final form for transmission to the Secretary of State, they will be referred to the Governments of the various colonies for revision and enlargement by those who have first-hand acquaintance with the subject in each.

It appears that in all the larger colonies, and in most of the smaller, serious and steadily growing efforts are being made to bring scientific agricultural instruction within the reach of those who aspire to become planters or managers of plantations, or scientific experts in tropical agriculture, and instructors, in their turn, of others.

It is natural that some of the boys who have had these advantages should turn to other callings in which scientific knowledge is required, and should migrate to other lands Nor is this to be deprecated. Experience has shown, however

that a large proportion apply the knowledge thus acquired to the purposes which are more directly in view. The West Indian colonies cannot be said, as a whole, to be in the van-guard of education in Natural Science; but there is perhaps no part of the British Empire in which a greater effort is made to make such education bear more directly upon the special requirements and opportunities of the population among which it is given. This special direction of aim has without doubt been largely stimulated by the work of the Imperial Department of Agriculture; and as the power of this Department to assist is gradually lessened by the diminution of the Imperial grant, it is of the utmost importance that the Governments and the peoples of these colonies should show themselves willing to continue, from their local resources, the required assistance.

The work done appears to fall under four headings :—

1. In some colonies, instruction in agricultural, as distinct from general, science is given in the secondary schools themselves. This method is perhaps most fully developed at Harrison College, Barbados. In this school, the services of a Lecturer in Agricultural Science, maintained from 1899-1907 by the Imperial Department of Agriculture, and acting under the Island Professor of Chemistry in the Government Laboratory which forms part of the college buildings, are almost entirely given during term time to an agricultural science class. To this class, boys are admitted who have reached the higher forms. More than half of their school hours are devoted to Natural Science; and they are instructed in physics, agricultural chemistry (theoretical and practical), botany, physiology, agriculture, and horticulture (with special reference to the agriculture of Barbados and neighbouring colonies), and the planting, manufacture, and analysis of sugar. At the end of a two-years' course, they may obtain a diploma upon an examination specially held for the purpose by the Cambridge Local Examination Syndicate; the diploma being countersigned by the Island Professor of Chemistry and the Head-master of the school. Exhibitions giving free education at Harrison College for this course have been given by the Imperial Department to boys belonging to Barbados, to the Windward Islands, and to the Leeward Islands respectively. They have been given preferably to sons of planters or managers of plantations; and only to boys who at the time of election have the intention of devoting themselves to agricultural work in the West Indies. It should be added that a carefully organized course of elementary science instruction is now given in the lower forms to all boys without exception, so that boys who intend to specialize in this subject will have their groundwork prepared before they enter the agriculture science class.

About seventy-two boys have been admitted to this class since 1899, of whom fourteen have been exhibitioners. The value of the work done has been proved by examiners' reports; and the callings, actually adopted by the exhibitioners who have left the school have, to a very large extent, justified the intention with which the exhibitions were given.

Special attention has been drawn to Harrison College on the present occasion, because the Imperial Department of Agriculture has now found it necessary to withdraw the salary of the Lecturer in Agricultural Science, and also the grant for the exhibitions. Without the Lecturer, the whole scheme would collapse; and a serious blow would be dealt to the general science teaching of the school. Without the exhibitioners the class need not indeed disappear, but its efficiency must be greatly lowered by the loss of some of the best boys; and a valuable opportunity is lost to some of the most deserving inhabitants of Barbados and of the other colonies concerned.

A proposal is now under consideration to make the Lecturer a permanent official of the Government Department of Science and Agriculture, paid from the Colonial Treasury. The Committee hope that the Conference will lend the weight of its influence to this proposal; and will also urge upon the Governments of Barbados, the Windward Islands, and the Leeward Islands respectively, that a system of exhibitions for agricultural science should be maintained.

The same method of teaching, in outline, is in use at Queen's College in British Guiana, the Queen's Royal College and St. Mary's College in Trinidad, and the Grammar School in Antigua. In Trinidad the boys of the two schools receive instruction in common at the Government Laboratory. The Lecturer, however, labours under a very great disadvantage in being without a Laboratory. In Antigua, the boys are taught by a Lecturer maintained by the Imperial Department, which also provides exhibitions enabling boys to attend the school for this purpose. In British Guiana, the work is done by the College staff in the College Laboratory. In these colonies however, no diploma is given. The students in Trinidad and in Antigua offer agricultural science as a subject in the examination for Cambridge Senior Local Certificates, after having taken chemistry for the Junior Local Certificate. The subject of agricultural science has been recently added to the syllabus, as the result of a request from the West Indies. In the opinion of those members of the Committee who have prepared boys for it, its treatment might with advantage be modified; and in British Guiana the examination is not used on account of the practical difficulties connected with it. A recommendation with regard to this will be found at the end of this report.

2. A second method is that which is found in use at Jamaica. At the Jamaica College regular courses are held in general science, but no specialized agricultural teaching is given. This work is done at the Government Laboratory for students, whether from the Jamaica College or elsewhere, who have left school. Scholarships are awarded by the Board of Agriculture to the most promising of these students at entrance, and at the close of the course a diploma is given upon a purely local examination. There were in the last year seven students working for this diploma. In respect of the time taken for training, this does not differ much from the Barbados scheme, as boys

intended for the course usually leave school at the age of seventeen, when, if they were at Harrison College, they might begin the course without leaving school. But the work in Jamaica, as unconnected with any school, may be found to open itself to a wider range of students.

At Montego Bay School in Jamaica, however, a start is being made upon the other plan; and practical agricultural instruction is given to boys in the school itself.

In connexion with this second method, it should be added that those who are concerned with the work in British Guiana are anxious to procure the establishment, by the Government, of a few scholarships to be competed for by Queen's College boys, and to be used for a two or three-years' course of theoretical and practical work under the Director of Science and Agriculture.

3. The third method has been adopted in certain smaller colonies in which, if a secondary school exists, no science is taught in it. This method is entirely due to the initiative of the Imperial Department, which has established in Dominica, St. Lucia, and St. Vincent, agricultural schools into which selected boys are passed from the elementary schools. The St. Kitt's-Nevis school, although called a Grammar and Agricultural School, may be brought under this head, as having been initiated by the Imperial Department for the same purpose. The aim of these schools is to give a practical instruction which shall equip boys for responsible work in plantations, rather than to produce scientific experts. There is in each school an average of about twenty boys, and of those who have already passed through the course, a satisfactory number, 50 per cent. and upwards, have remained to work in the island where they have been taught.

In each of these colonies, the school, which was at first maintained entirely by the Imperial Department, is now supported to the extent of at least one-half of the expense by the Government, and it is hoped that this local aid may gradually be increased.

4. A further method is in use at the Government Laboratory in Trinidad, at which arrangements have existed since 1893 by which any person, wishing to receive special agricultural instruction to qualify him for holding an appointment for which some technical knowledge or skill is required, may avail himself of this instruction at a nominal cost.

CONCLUSION.

It is evident to the Committee, upon their general review of the subject, that a very notable advance has been made in the last eight years in the promotion of agricultural education of the higher kind in the West Indian colonies. This must have, and is having, a further effect, not less important to the general interest of the colonies, in stimulating the progress of general science teaching in the secondary schools. There is, moreover plenty of evidence that the efforts made are appreciated, and that planters are increasingly ready to

employ those who have been trained on the methods here indicated. Nor should it be forgotten that the work as it advances will develop a generative faculty, and will produce not only men who will be able to apply scientific method to the practical work of production, but also men who will be competent themselves to give valuable aid in the work of instruction. In this manner, the schemes of higher instruction are the necessary coping stone of the edifice, the foundations of which are laid in the elementary schools.

It remains for the Government of these colonies to carry on and extend the work which has been so well begun.

The conclusions reached in this report are summed up by the Committee in the following recommendations:—

1. That every effort should be made to induce the Governments of the West Indian Colonies to take up in a liberal spirit the work of agricultural instruction in all its branches.

2. That in every secondary school a systematic course of instruction in chemistry, elementary physics, and botany should be given to all pupils at some stage of their career; this being important both for its general educative value, and as a groundwork for those who need higher instruction in science for agricultural or other purposes.

3. That an effort should be made to maintain, from the funds of the colonies concerned, the exhibitions to Harrison College from Barbados, the Windward Islands, and the Leeward Islands, heretofore given by the Imperial Department of Agriculture.

4. That it is desirable that scholarships should be established by the Government of British Guiana, which shall enable selected boys from Queen's College, Demerara, to pursue a course of agricultural study under the Director of Science and Agriculture.

5. That the Cambridge Syndicate of Local Examinations be asked to consider the opinion expressed by those who have prepared boys in the new subject of agricultural science, that the questions set are too difficult for students after one year's specialized instruction limited to about four hours a week, and that a remedy may be found in reserving the present standard for the examination held at the end of two years' instruction, and in making a lower standard for the examination held at the end of the first year.

W. P. BARBADOS, (President.)
HERBERT A. DALTON.
J. P. D'ALBUQUERQUE.
T. A. POPE.
J. H. COLLENS.
J. E. REECE.
C. A CONDELL.
P. CARMODY.
LONGFIELD SMITH.
AUSTIN H. KIRBY.

REPORT OF THE EXPERIMENT STATION COMMITTEE.

The Committee appointed to consider this question recommend :—

(1) That it is of the highest importance to the progress of the agricultural industries of the West Indies and British Guiana that there should be one or more Central Agricultural Stations in each colony.

(2) That the officers attached to these stations should devote themselves solely to the investigation, under modern scientific methods, of the special problems affecting the agricultural industries of each colony.

(3) That it is desirable that Advisory Boards of Planters should be appointed in connexion with the management and control of these stations.

(4) That expert officers, such as an Entomologist, a Mycologist, a Veterinary Surgeon or other specialist, should be appointed to one of these Central Stations when required, and that their salaries be paid by contributions apportioned among the different colonies interested.

(5) That these recommendations be forwarded to the Governments of the various West Indian colonies and British Guiana.

F. J. CLARKE,
(Chairman.)

REPORT OF TOBACCO COMMITTEE.

Present :--Hon. FRANCIS WATTS, Messrs. J. R. BOVELL, J. H. HART, J. C. MOORE, R. D. ANSTEAD, W. N. SANDS, F. R. SHEPHERD, J. JONES, and Hon. W. FAWCETT, who was elected Chairman.

The Committee on Tobacco begs to report that the services of an expert would be useful at St. Kitt's, and possibly also at St. Lucia, but in the rest of the Windward and Leeward Islands, and in Barbados, so much attention is being given to cotton that there is little hope at present of tobacco being taken up.

It might be possible to get two or three apprentices from the Jamaica Gardens to give instruction for six months at a moderate cost.

W. FAWCETT,
(Chairman.)

ERRATA IN THE PRESENT VOLUME.

Page 41, line 3, *for* 'commutations' *read* 'computations.'

„ 78, line 20 from bottom, *for* 'in' *read* 'and.'

„ 98, line 14 from bottom, *for* 'nitrate' *read* 'nitrite.'

„ 138, line 4 from bottom, *after* 'done' *add* 'in the case of one youth.'

„ 141, (in some copies) in heading of article, *for* 'Grenada *read* 'Trinidad.'

Imperial Department of Agriculture

FOR THE WEST INDIES.

HEAD OFFICE—BARBADOS.

Imperial Commissioner of Agriculture for the West Indies — The Hon. SIR DANIEL MORRIS, K.C.M.G., D.Sc., D.C.L., M.A., F.L.S., F.R.H.S., C.M.Z.S.

Scientific Assistant ... ... WALTER BIFFEN, B.Sc.

Entomologist ... ... HENRY A. BALLOU, M.Sc.

Mycologist and Agricultural Lecturer — F. A. STOCKDALE, B.A. (Cantab.), F.L.S.

Travelling Inspector in connexion with Cotton Investigations — THOMAS THORNTON, A.R.C.S.

Chief Clerk ... . ALLEYNE GRAHAM HOWELL.

Assistant Clerk ... ... MURRELL B. CONNELL.

Junior Clerk ... . ERIC G. ST. HILL.

Typist .. .. BEATRICE ROBINSON.

Temporary Assistants ... — A. B. PRICE, Fell. Journ. Inst.; A. W. STRAUGHAN.

Messenger ... ... E. E. LEACOCK.

Honorary Consulting Chemists to the Imperial Department of Agriculture,

Professor J. B. HARRISON, C.M.G., M.A., F.I.C., F.C.S., F.G.S.

Professor J. P. D'ALBUQUERQUE, M.A., F.I.C., F.C.S.

Government Analytical and Agricultural Chemist and Superintendent of Agriculture for the Leeward Islands,

The Hon. FRANCIS WATTS, C.M.G., D.Sc., F.I.C., F.C.S.

List of Staffs of Colonial Establishments.

BARBADOS.

Botanic Station.

Superintendent	J. R. Bovell, F.L.S., F.C.S.
Clerical Assistant... ...	C. E. Stoute.

Sugar-cane Experiments.

Chemist-in-charge ...	Professor J. P. d'Albuquerque, M.A., F.I.C., F.C.S.
Laboratory Assistant ...	C. T. Allder.
Pupil Assistant	H. M. Clark.
Agricultural Sup'dent ...	J. R. Bovell, F.L.S., F.C.S.
Assistant do. ...	J. S. Dash.
Junior Assistant	H. Bourne.

Lecturer in Agricultural Science	Longfield Smith, B.Sc. (Edin.), Ph.D. (Leipzig).

ST. VINCENT.

Botanic Station.

Agricultural Sup'dent ...	W. N. Sands.
Foreman	O. Warner.

Agricultural Experiments and Education.

Agricultural Instructor...	Thomas Osment.
Resident Master of Agricultural School	W. H. Patterson.
Assistant Master... ..	Stanley Todd.

ST. LUCIA.

Botanic Station.

Agricultural Sup'dent ...	J. C. Moore.
Foreman	Elias Buckmire.

Agricultural Experiments and Education.

Agricultural Instructor...	———
Officer-in-charge of Agricultural School	J. C. Moore.
Schoolmaster	R. W. Niles.
Overseer	J. Connell.

List of Staffs of Colonial Establishments.—(*Continued.*)

GRENADA.

Botanic Station.

Agricultural Sup'dent ...	R. D. ANSTEAD, B.A. (Cantab.).
Agricultural Instructor...	GEO. F. BRANCH.
Foreman	J. C. CALLENDER.

LEEWARD ISLANDS.

Government Chemist and Supt. of Agriculture	The Hon. FRANCIS WATTS, C.M.G., D.Sc., F.I.C., F.C.S.
Assistant Chemist	HAROLD A. TEMPANY, B.Sc. (Lond.), F.I.C., F.C.S.
Junior Assistant	R. H. MALONE.

ANTIGUA.

Botanic Station.

Curator	THOMAS JACKSON.
Foreman (Acting) ...	A. THIBOU.

Agricultural Experiments and Education.

Acting Agricultural Assistant	W. J. ABBOTT.

Agricultural and Science Master	A. H. KIRBY, B.A.

ST. KITT'S-NEVIS.

Botanic Station.

Agricultural Sup'dent ...	F. R. SHEPHERD.
Foreman	———

Agricultural Experiments and Education.

Agricultural Sup'dent ...	F. R. SHEPHERD.

Agricultural and Science Master	H. O. M. REILLY, (Acting).

Agricultural Instructor (Nevis)	J. O. MALONEY.

List of Staffs of Colonial Establishments.—(*Continued.*)

DOMINICA.

Botanic Station.

Curator	JOSEPH JONES.
Foreman	J. F. BAPTISTE.

Agricultural Experiments and Education.

Agricultural Instructor...	————
Officer-in-charge of Agricultural School	ARCHIBALD BROOKS.
Schoolmaster	T. H. ANGOL.

MONTSERRAT.

Botanic Station.

Curator	WM. ROBSON.
Local Instructor	DUDLEY JOHNSON.

VIRGIN ISLANDS.

Agricultural Instructor...	W. C. FISHLOCK.

BRITISH HONDURAS.

Botanic Station.

Curator	EUGENE CAMPBELL.

TRINIDAD.

Royal Botanic Gardens.

Superintendent	J. H. HART, F.L.S.
Asst. Superintendent	F. EVANS.
Curator (Govt. House)	————
Clerk	H. C. MASSY.
Overseer (St. Clair)	A. COLLENS.
Herbarium Assistant	PAULINE McLEAN.
Agricultural Instructors ...	———— H. A. NURSE.
Manager (River Estate) ...	J. C. AUGUSTUS.

TOBAGO.

Botanic Station.

Superintendent	J. H. HART, F.L.S.
Curator	HENRY MILLEN.
Agricultural Instructor...	N. LORD.
Foreman	J. BLACKMAN.

List of Staffs of Colonial Establishments. (*Concluded.*)

JAMAICA.

Department of Public Gardens and Plantations.

Director	The Hon. WM. FAWCETT, B.Sc., F.L.S.
Supt. of Hope Gardens and Experiment Station, Hill Gardens, and Castleton Gardens	WILLIAM HARRIS, F.L.S.
Assistant Supt. of Hope Gardens	———
Assistant Supt. of Castleton Gardens	JOHN CAMPBELL.
Supt. of King's House Gardens	WILLIAM J. THOMPSON.
Supt. of Parade Gardens ...	JAMES BRISCOE.
Clerk at Head Office	F. N. ISAACS.
Assistant and Typist	HELEN ADELAIDE WOOD.

Agricultural Experiments and Education.

Government Analytical and Agricultural Chemist	The Hon. HERBERT H. COUSINS, M.A., F.C.S.
Assistant Chemist	R. SIMMONS.
Second Assistant	G. D. GOODE.
Sugar Experiment Station:	
Chemist-in-charge	The Hon. H. H. COUSINS.
Fermentation Chemist ...	S. F. ASHBY, B.Sc.
Superintendent of Sugar-cane Experiments	PERCIVAL W. MURRAY.
Lecturer in Agricultural Science	E. J. WORTLEY.
Travelling Instructors in Agriculture	WILLIAM CRADWICK JAMES BRISCOE.
Agricultural Instructor at Hope Experiment Station	W. J. DOWN.

BRITISH GUIANA.

Director of Science and Agriculture	Prof. J. B. HARRISON, C.M.G., M.A., F.I.C., F.C.S., F.G.S.

Botanic Gardens.

Superintendent	A. W. BARTLETT, B.A., B.Sc., F.L.S.
Head Gardener	JOHN F. WABY, F.L.S.
Assistant Gardener	———
Clerical Assistant	E. S. CHRISTIANI.
Keeper (Berbice)	J. NARDAMOONIE.

Agricultural Experiments and Education.

Agricultural Assistant ...	ROBERT WARD.
Science Master (Queen's College)	E. W. F. ENGLISH, M.A.
Normal and Agricultural Master	WILLIAM GRAY.

INDEX.

A.

B.

D.

E.

F.

G.

H.

I.

J.

L.

M.

N.

O.

P.

Q.

R.

T.

V.

(25/4)

W.